EXHIBIT B

REDACTED VERSIONS OF DOCUMENTS TO BE SEALED

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN

Carrum Technologies, LLC, Plaintiff, v. FCA US LLC, Defendant. C.A. No. 18-cv-1646-RGA United States District Court for the District of Delaware	Misc. Case No.

PLAINTIFF'S MOTION TO COMPEL COMPLIANCE WITH RULE 45 SUBPOENA ISSUED FROM THE DISTRICT OF DELAWARE TO NON-PARTY BOSCH

Plaintiff Carrum Technologies, LLC ("Carrum"), by and through its undersigned attorneys, and pursuant to FED. R. CIV. P. 37(a) and 45, hereby moves this Court for entry of an order compelling the production of documents by Robert Bosch LLC ("Bosch"). This Motion is supported by an accompanying Brief, Declaration of Jason Murray (Ex. 15), and Declaration of Prof. Gregory Shaver, Ph.D. (Ex. 16).

Pursuant to FED. R. CIV. P. 37 and Local Rule 7.1, Plaintiff's counsel hereby certifies that they conferred with counsel for Bosch in an attempt to obtain the requested discovery without court action, but the parties were unable to reach a resolution to avoid the need for the making of this Motion.

December XX, 2021

Respectfully submitted,

/s/

James L. Kresta
jkresta@jaffelaw.com
JAFFE, RAITT, HEUER & WEISS, PC
27777 Franklin Rd, Suite 2500
Southfield, MI 48034
Tel: (248) 351-3000

Andrew C. Baak
andrew.baak@bartlitbeck.com
Jason C. Murray
jason.murray@bartlitbeck.com
BARTLIT BECK LLP
1801 Wewatta Street, Suite 1200
Denver, CO 80202
Tel: (303) 592-3100

Counsel for Plaintiff
Carrum Technologies, LLC

CERTIFICATE OF SERVICE

I hereby certify that on December XX, 2021, a copy of the document above was served on the following counsel by electronic mail:

Lionel M. Lavenue
lionel.lavenue@finnegan.com
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, LLP
1875 Explorer Street
Suite 800
Reston, VA 20190-6023
Tel: (571) 203-2750

Counsel for Bosch

/s/

James L. Kresta
jkresta@jaffelaw.com
JAFFE, RAITT, HEUER & WEISS, PC
27777 Franklin Rd, Suite 2500
Southfield, MI 48034
Tel: (248) 351-3000

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN

Carrum Technologies, LLC, Plaintiff, v. FCA US LLC, Defendant. C.A. No. 18-cv-1646-RGA United States District Court for the District of Delaware	Misc. Case No.

BRIEF IN SUPPORT OF PLAINTIFF'S MOTION TO COMPEL COMPLIANCE WITH RULE 45 SUBPOENAS ISSUED FROM THE DISTRICT OF DELAWARE TO NON-PARTY BOSCH

[FILED UNDER SEAL]

CONCLUSION

For the reasons stated above, Carrum respectfully requests that the Court grant its motion to compel the production of all non-privileged documents, including source code, in Bosch's possession or control responsive to the Subpoenas.

December XX, 2021

Respectfully submitted,

/s/ _____

James L. Kresta
jkresta@jaffelaw.com
JAFFE, RAITT, HEUER & WEISS, PC
27777 Franklin Rd, Suite 2500
Southfield, MI 48034
Tel: (248) 351-3000

Andrew C. Baak
andrew.baak@bartlitbeck.com
Jason C. Murray
jason.murray@bartlitbeck.com
BARTLIT BECK LLP
1801 Wewatta Street, Suite 1200
Denver, CO 80202
Tel: (303) 592-3100

Counsel for Plaintiff
Carrum Technologies, LLC

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Lionel M. Lavenue
lionel.lavenue@finnegan.com
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, LLP
1875 Explorer Street
Suite 800
Reston, VA 20190-6023
Tel: (571) 203-2750

Counsel for Bosch

/s/

James L. Kresta
jkresta@jaffelaw.com
JAFFE, RAITT, HEUER & WEISS, PC
27777 Franklin Rd, Suite 2500
Southfield, MI 48034
Tel: (248) 351-3000

EXHIBIT 1

US007512475B2

(12) **United States Patent**
Perisho, Jr. et al.

(10) **Patent No.: US 7,512,475 B2**
(45) **Date of Patent: Mar. 31, 2009**

(54) **AUTOMATIC LATERAL ACCELERATION LIMITING AND NON THREAT TARGET REJECTION**

(75) Inventors: **Robert A. Perisho, Jr.**, Russiaville, IN (US); **Jeremy S. Greene**, Fishers, IN (US)

(73) Assignee: **Delphi Technologies, Inc.**, Troy, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 743 days.

(21) Appl. No.: **10/804,745**

(22) Filed: **Mar. 19, 2004**

(65) **Prior Publication Data**

US 2005/0209766 A1 Sep. 22, 2005

(51) **Int. Cl.**
B60K 31/00 (2006.01)
G06F 19/00 (2006.01)

(52) **U.S. Cl.** **701/96**; 701/72; 701/78; 180/170

(58) **Field of Classification Search** 701/96, 701/72, 74, 78, 79, 301; 180/170
See application file for complete search history.

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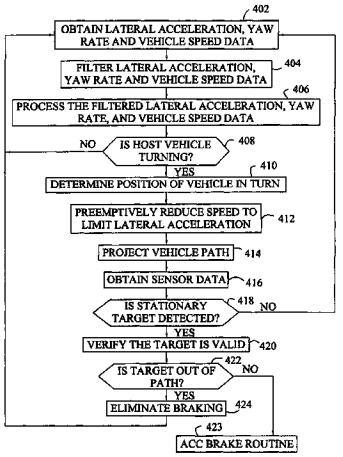
Primary Examiner—Tan Q Nguyen
(74) *Attorney, Agent, or Firm*—Douglas D. Fekete

(57) **ABSTRACT**

The present invention provides a system and method for enabling a vehicle having adaptive cruise control to reduce its speed in a turn according to the vehicle's position within the turn as well as ignoring objects detected during the turn that are not in the vehicle's path. The method of the present invention includes the steps of operating the vehicle in an adaptive cruise control mode such that the vehicle is traveling at a set speed; determining whether the vehicle is in a turn in the vehicle's path by detecting change in the vehicle's lateral acceleration; and when the vehicle is determined to be in the turn, reducing the vehicle's speed according to the vehicle's position in the turn, monitoring for objects and maintaining the vehicle's speed if an object is positioned out of the path of the vehicle.

12 Claims, 5 Drawing Sheets



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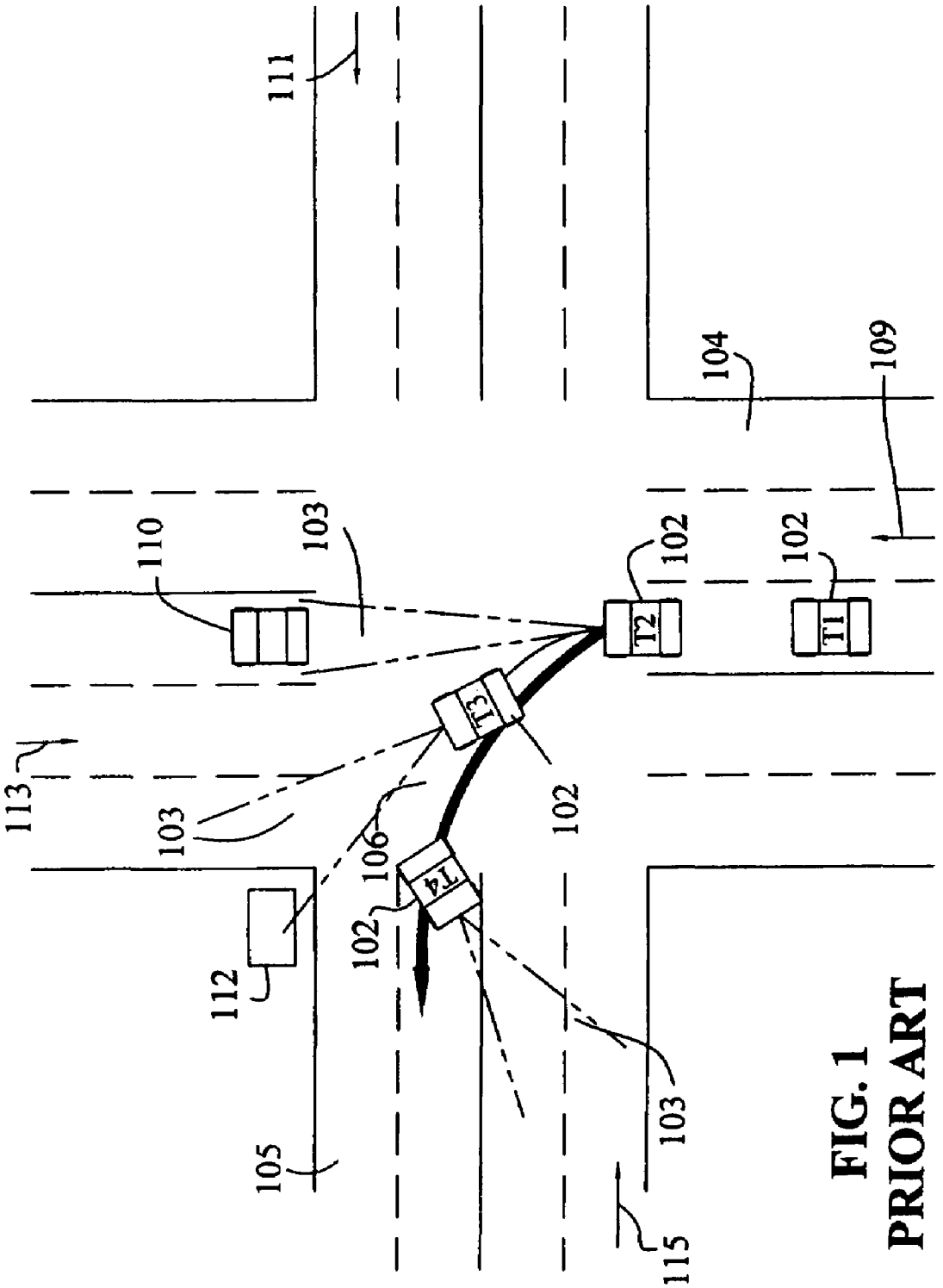

FIG. 1
PRIOR ART

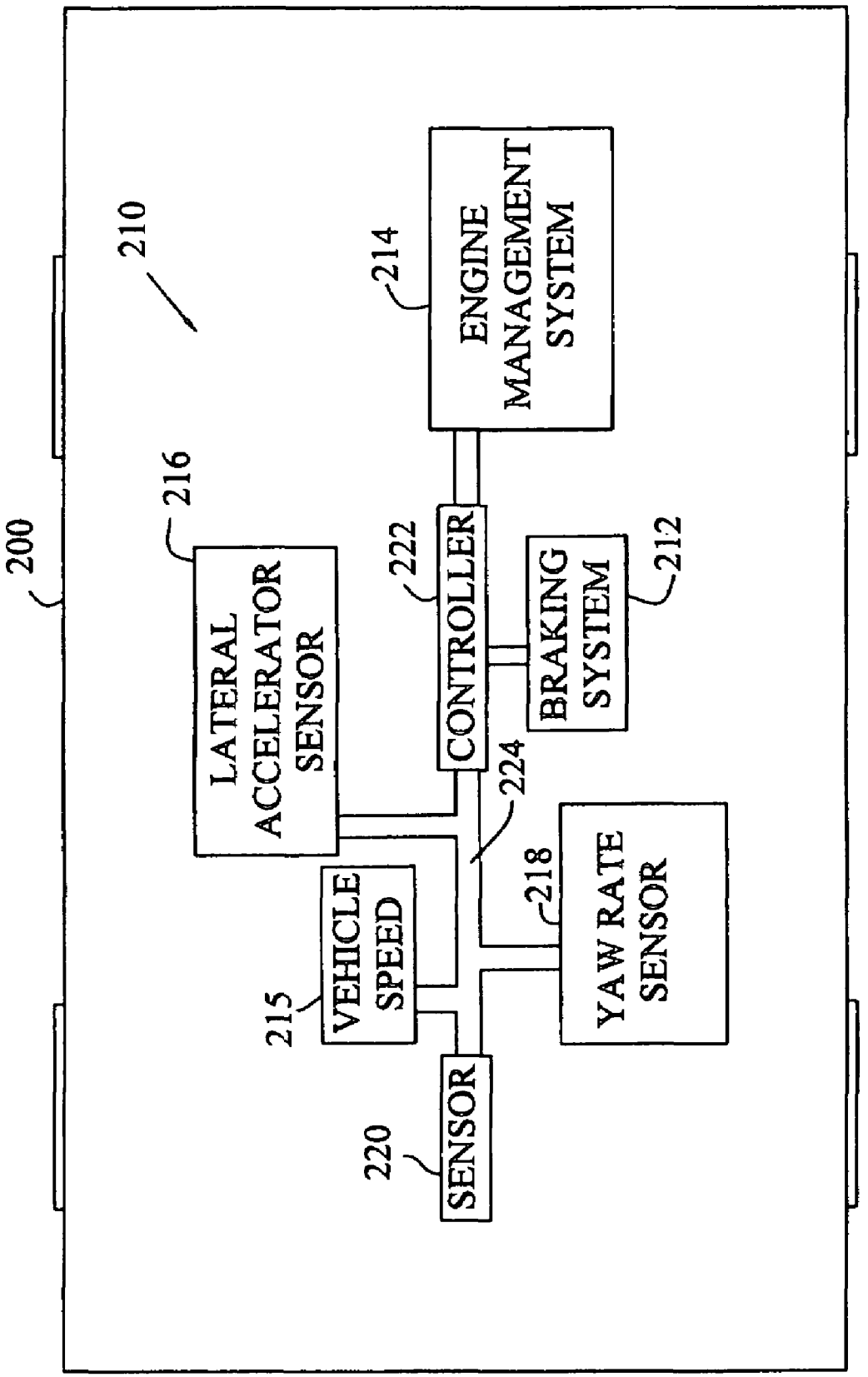
200
210
214
ENGINE MANAGEMENT SYSTEM
216
LATERAL ACCELERATOR SENSOR
222
CONTROLLER
BRAKING SYSTEM
212
224
218
YAW RATE SENSOR
215
VEHICLE SPEED
220
SENSOR

FIG. 2

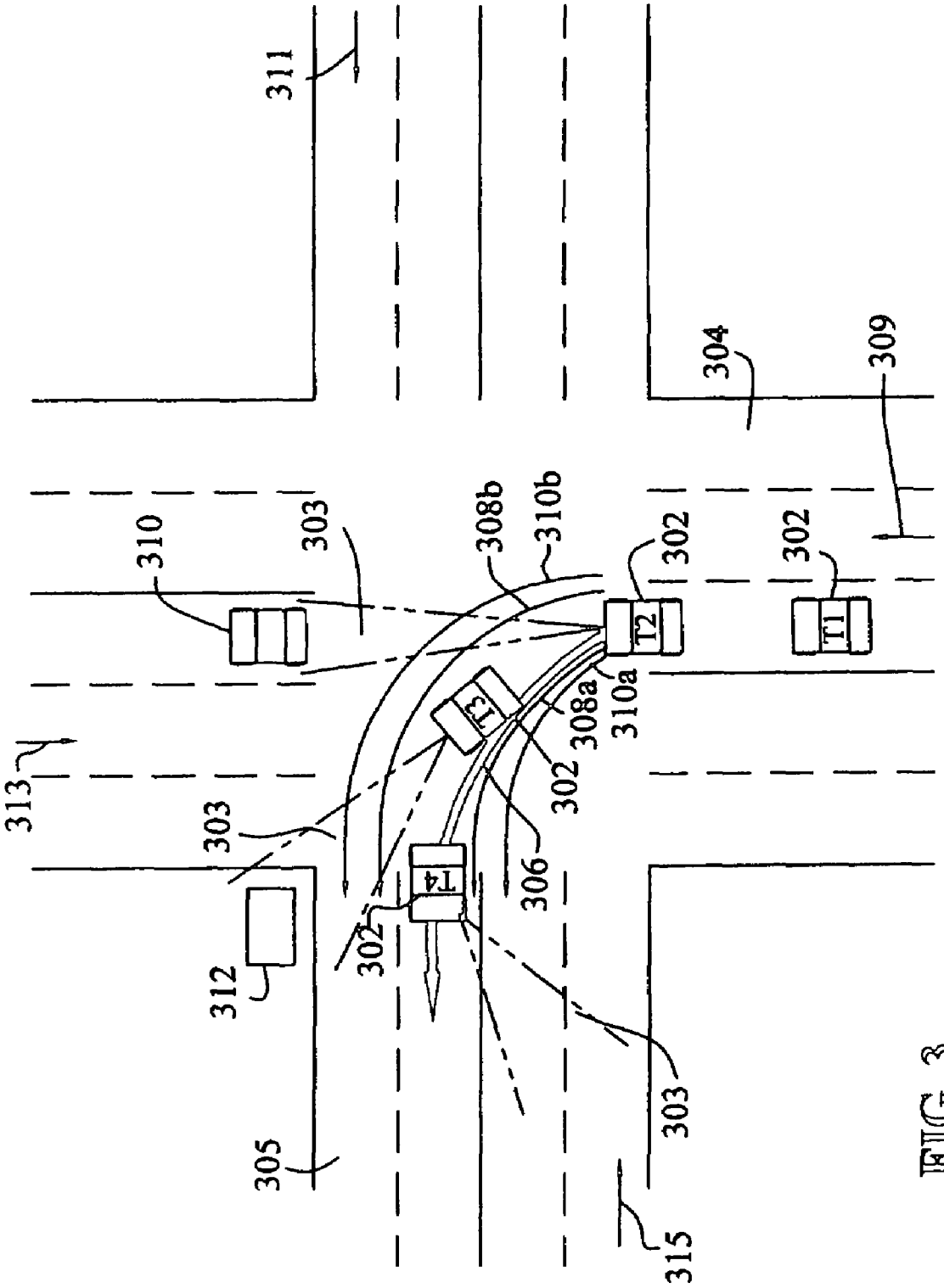
311
304
309
310
303
308b
310b
302
302
T2
T1
T3
308a
310a
313
303
302
306
T4
302
312
305
303
315

FIG. 3

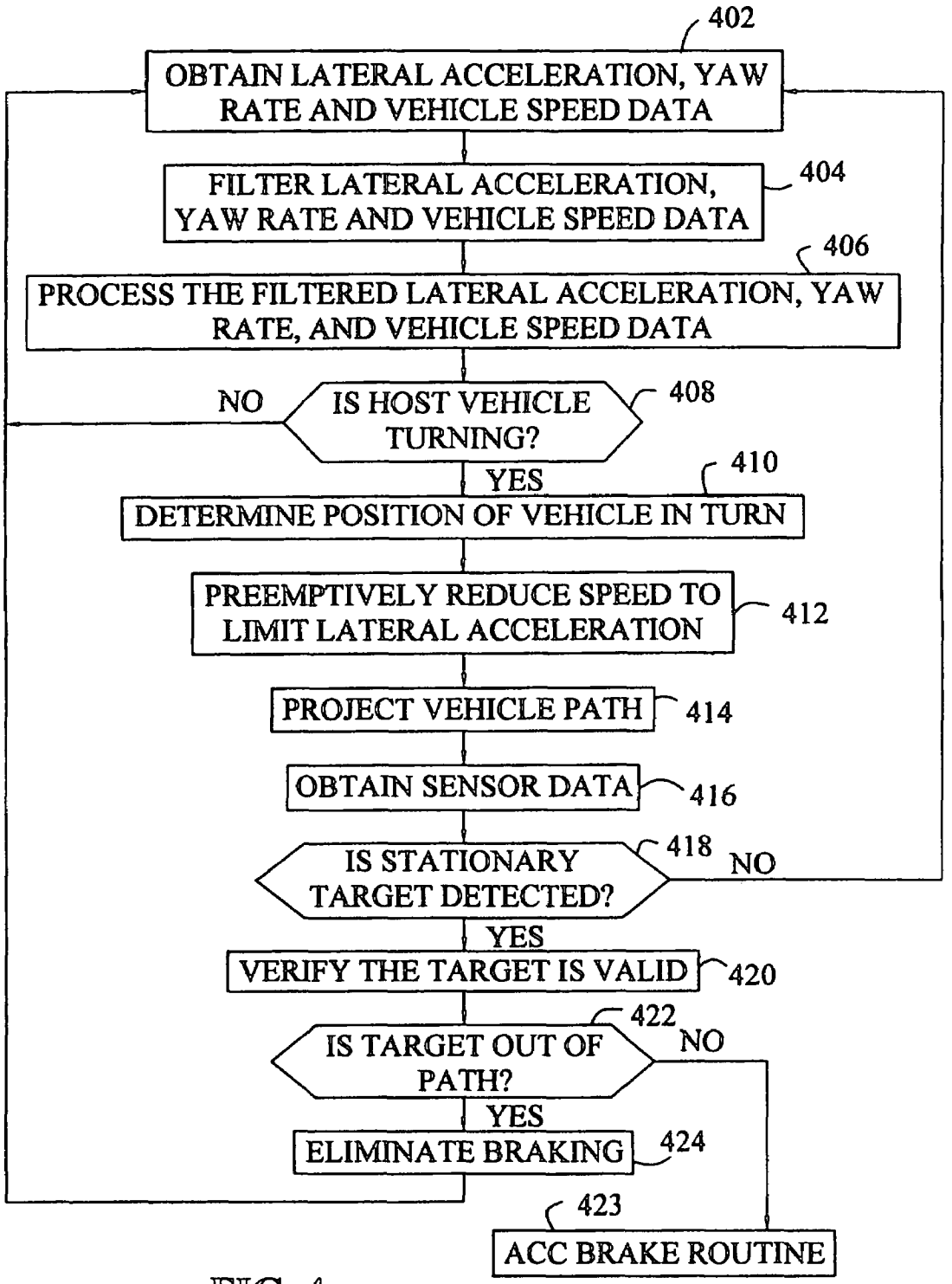
402
OBTAIN LATERAL ACCELERATION, YAW RATE AND VEHICLE SPEED DATA
404
FILTER LATERAL ACCELERATION, YAW RATE AND VEHICLE SPEED DATA
406
PROCESS THE FILTERED LATERAL ACCELERATION, YAW RATE, AND VEHICLE SPEED DATA
NO
408
IS HOST VEHICLE TURNING?
YES
410
DETERMINE POSITION OF VEHICLE IN TURN
PREEMPTIVELY REDUCE SPEED TO LIMIT LATERAL ACCELERATION
412
PROJECT VEHICLE PATH
414
OBTAIN SENSOR DATA
416
418
IS STATIONARY TARGET DETECTED?
NO
YES
VERIFY THE TARGET IS VALID
420
422
IS TARGET OUT OF PATH?
NO
YES
ELIMINATE BRAKING
424
423
ACC BRAKE ROUTINE

FIG. 4

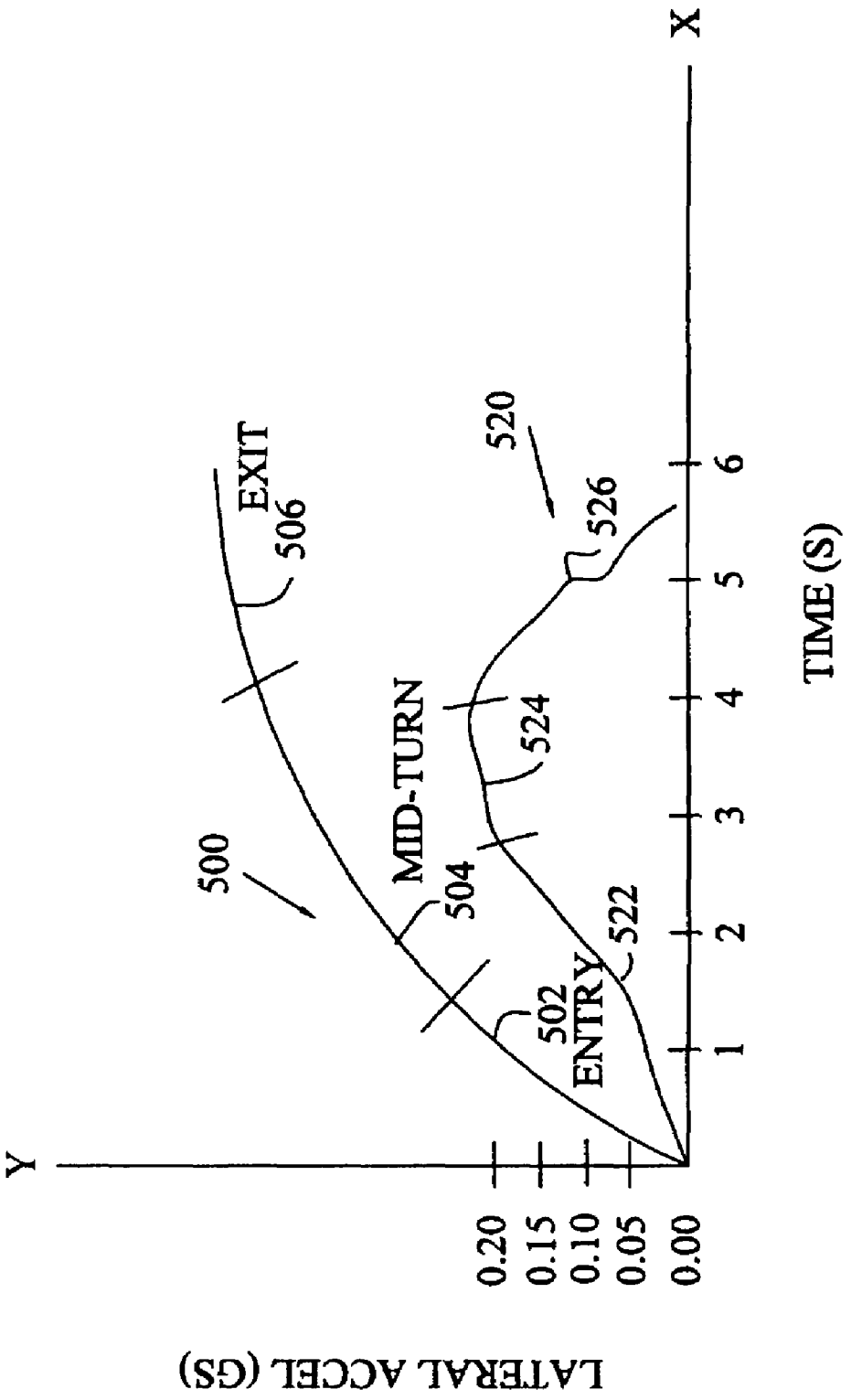
X
Y
TIME (S)
LATERAL ACCEL (GS)
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
500
502
ENTRY
504
MID-TURN
506
EXIT
520
522
524
526

FIG. 5

AUTOMATIC LATERAL ACCELERATION LIMITING AND NON THREAT TARGET REJECTION

TECHNICAL BACKGROUND

The present invention generally relates to a vehicle which contains an adaptive cruise control ("ACC") system. Specifically, this invention relates to a method and system for controlling a vehicle having an ACC system.

BACKGROUND OF THE INVENTION

Cruise control systems for automotive vehicles are widely known in the art. In basic systems, the driver of a vehicle attains a desired vehicle speed and initiates the cruise control system at a set speed. The vehicle then travels at the set speed until the driver applies the brakes or turns off the system.

Advances in vehicle electronics and sensory technology have provided for cruise control systems that go a step beyond the system described above. ACC systems are not only capable of maintaining a set vehicle speed, but they also include object sensing technology, such as radar, laser, or other types of sensing systems, that will detect a vehicle in the path of the vehicle that contains the ACC (or other form of cruise control) system (i.e., "host vehicle"). Accordingly, ACC is an enhancement to traditional cruise control by automatically adjusting a set speed to allow a vehicle to adapt to moving traffic.

Under normal driving conditions the ACC system is engaged with a set speed equal to a maximum speed that is desired by the vehicle driver, and the ACC system operates in a conventional cruise control mode. If the host vehicle is following too closely behind a vehicle in the path of the host vehicle ("in-path vehicle"), the ACC system automatically reduces the host vehicle's speed by reducing the throttle and/or applying the brakes to obtain a predetermined safe following interval. When the in-path vehicle approaches slow traffic and the ACC system reduces the speed of the host vehicle below a minimum speed for ACC operation, the ACC automatically disengages and the driver manually follows slower in-path vehicles in the slow traffic. When the slow traffic is no longer in front of the host-vehicle, the driver must manually accelerate the host vehicle to a speed above the minimum speed for ACC operation before the ACC system is able to resume acceleration to the set speed. In typical ACC systems, objects moving at approximately 30% (thirty percent) or less of the host vehicle's speed are disregarded for braking purposes (i.e., the vehicle's brakes are not applied, the throttle is not reduced, and no other action is taken to slow down the host vehicle).

Traditional ACC systems were designed to enable a vehicle to react to moving targets presented by normal traffic conditions under extended cruise control operation and when the vehicle is traveling at speeds above forty (40) kilometers per hour (KPH). "Stop-and-go" ACC systems are an enhanced form of ACC that overcome some of the shortcomings of ACC systems. Stop-and-go ACC systems enable the host vehicle to follow an in-path vehicle in slower traffic conditions such as stop and go traffic. Therefore, while ACC stop-and-go systems improve the performance of traditional ACC systems, both ACC and ACC stop-and-go systems still provide problems for the driver of the vehicle.

A first problem presented by ACC and ACC stop-and-go systems is that because there may be an abundance of out-of-path stationary targets encountered by a vehicle during a turn, braking for each of these targets can cause driver discomfort.

Current ACC and ACC stop-and-go systems are not capable of disregarding the stationary targets not within the vehicle's path (i.e., "out-of-path" targets). An example is shown in FIG. **1**, in which vehicle **102** utilizes a prior art ACC or ACC stop-and-go system. Vehicle **102** is shown at three (4) different times—time one ("T**1**"), time two ("T**2**"), time three ("T**3**") and time four ("T**4**"). At T**1**, vehicle **102** is shown traveling in the direction of arrow **109** at a cruise speed on road **104**. In-path indicator **103** highlights objects that are in the path of vehicle **102** as vehicle **102** travels. As vehicle **102** enters a left turn at T**2**, which is illustrated by arrow **106** ("turn **106**"), in-path indicator **103** illustrates that stationary object **110** is within vehicle's **102** path. Object **110** may be any stationary object, for example, a traffic light, a stopped vehicle, construction equipment, a person, an animal, a sign, or any other object. Since object **110** is in the path of vehicle **102**, the ACC or ACC stop-and-go system contained by vehicle **102** appropriately instructs vehicle **102** to either brake or reduce its speed in some fashion. This situation, however, is an unnecessary braking situation because vehicle **110** is not a threat to vehicle **102** at T**2**.

As vehicle **102** is midway through turn **106** at T**3**, vehicle **102** detects stationary object **112**, as highlighted by in-path indicator **103**. Because object **112** is in the path of vehicle **102**, vehicle's **102** ACC or ACC stop-and-go system brakes and reduces vehicle's **102** speed. Object **112**, however, like object **110**, is non-threatening to vehicle **102**. Therefore, in making turn **106**, vehicle's **102** ACC or ACC stop-and-go system unnecessarily reduces the speed of vehicle **102**. This excessive braking may annoy and provide discomfort to the driver of vehicle **102**.

Another problem presented by current ACC and ACC stop-and-go systems is that the systems' maintenance of a set cruise speed in turning situations may cause excessive lateral acceleration and the possible loss of control of the host vehicle. An example is shown in FIG. **1**. As vehicle **102** enters turn **106**, maintaining the cruise speed may cause excessive lateral acceleration. Vehicle **102**, shown at T**4**, illustrates how the excessive lateral acceleration can cause vehicle's **102** tail to careen out of vehicle's **102** desired turn **106**. Excessive lateral acceleration such as that described in this example may result in injury to the driver of vehicle **102** as well as to nearby vehicle drivers or pedestrians.

SUMMARY OF THE INVENTION

The method and system of the present invention provides smooth vehicle control in turning situations both by limiting lateral acceleration during the vehicle turn and by eliminating braking for out-of-path targets.

In one form of the present invention, a method of controlling a vehicle having an adaptive cruise control system capable of obtaining the vehicle's lateral acceleration is provided, the method including the steps of determining when the vehicle is in a turn based on a detected change in the vehicle's lateral acceleration; and reducing the vehicle's speed according to the vehicle's position in the turn.

In another form of the present invention, a method of controlling a vehicle is provided, the method including the steps of operating the vehicle in an adaptive cruise control mode such that the vehicle is traveling at a set speed; determining whether the vehicle is in a turn in the vehicle's path by detecting change in the vehicle's lateral acceleration; and when the vehicle is determined to be in the turn, reducing the vehicle's speed according to the vehicle's position in the turn, monitoring for objects and maintaining the vehicle's speed if an object is positioned out of the path of the vehicle.

In still another form, the present invention provides a method of controlling a vehicle operating in an adaptive cruise control mode and traveling at a set speed, the method including the steps of estimating a path for the vehicle in a turn; associating the vehicle path with a first zone area, the first zone area including the turn; and reducing the vehicle's speed when a detected object is determined to be in the first zone area and maintaining the vehicle's speed when a detected object is determined to be outside of the first zone area.

In yet another form of the present invention, a system is provided for use in controlling a vehicle, the system including an adaptive cruise control system; a controller in communication with the adaptive cruise control system and capable of determining when the vehicle is in a turn, the controller operative to reduce the vehicle's speed according to the vehicle's position in the turn; at least one lateral acceleration sensor for generating a signal corresponding to the vehicle's lateral acceleration, the lateral acceleration sensor in electrical communication with the controller and operative to detect a change in the vehicle's lateral acceleration; and at least one object detection sensor for detecting an object in the path of the vehicle during the turn, the object detection sensor in electrical communication with the controller, wherein the controller includes control logic operative to determine whether the object is in the vehicle's path during the turn and ignoring the object for braking purposes when the object is not determined to be in the vehicle's path.

In another form of the present invention, a method of controlling a vehicle in a turn is provided, the method including the steps of measuring the vehicle's speed; measuring the vehicle's lateral acceleration; estimating the radius of curvature of the vehicle's path based on the vehicle's speed and lateral acceleration; and when the combination of the vehicle's speed and the vehicle path's radius of curvature exceeds a predetermined maximum lateral acceleration limit, reducing the vehicle's speed.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and objects of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a diagrammatic view of a vehicle having a prior art ACC or ACC stop-and-go ACC system in a turn situation;

FIG. **2** is a schematic view of a vehicle including the system of the present invention;

FIG. **3** is a diagrammatic view of a vehicle having the inventive system in a turn situation;

FIG. **4** is a illustrative view of the method of the present invention; and

FIG. **5** charts the lateral acceleration of a vehicle in a turn situation.

Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of the present invention, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the present invention. The exemplifications set out herein illustrate embodiments of the invention in several forms and such exemplification is not to be construed as limiting the scope of the invention in any manner.

DESCRIPTION OF INVENTION

The embodiments disclosed below are not intended to be exhaustive or limit the invention to the precise forms disclosed in the following detailed description. Rather, the embodiments are chosen and described so that others skilled in the art may utilize their teachings.

FIG. **2** shows the inventive stop-and-go adaptive cruise control (ACC) system **210** of the present invention. While system **210** is described within the context of an ACC stop-and-go system, it is contemplated that system **210** may also be used in a traditional ACC system. System **210** is implemented in host vehicle **200** that has braking system **212** and engine management system **214**. System **210** includes vehicle speed sensor **215** for measuring vehicle's **200** speed, lateral acceleration sensor **216** for measuring the acceleration of vehicle **200** in the direction of vehicle's **200** lateral axis in a turn, and yaw rate sensor **218** for measuring the rate that vehicle **200** is rotating about its vertical axis. System **210** also includes sensor **220** for generating a range signal corresponding to a distance between host vehicle **200** and a target, and a target range rate signal corresponding to a rate that the distance between host vehicle **200** and the target is changing. Controller **222** is in electronic communication with sensors **215**, **216**, **218**, **220** over communication bus **224**.

Braking system **212** may include any braking system that is capable of reducing the speed of vehicle **200**. Such braking mechanisms include a transmission controller that is capable of downshifting a transmission of vehicle **200**, a throttle that may be reduced to decrease the speed of vehicle **200**, a brake booster controller equivalent to the vehicle's driver applying the brakes, etc.

Engine management system **214** may include any known vehicle component or system that may be used to adjust the acceleration of vehicle **200**. Such components and/or systems may include a vehicle accelerator, a fuel and air intake control system, or an engine timing controller.

Sensor **220** may include any object detecting sensor known in the art, including a radar sensor (e.g., doppler or microwave radar), a laser radar (LIDAR) sensor, an ultrasonic radar, a forward looking IR (FLIR), a stereo imaging system, or a combination of a radar sensor and a camera system. Sensor **220** functions to detect objects positioned in the path of vehicle **200**. For example, shown in FIGS. **1** and **3**, in-path indicators **103**, **303** depict sensor's **220** capability to detect an object in the path of vehicles **103**, **303**, respectively. Sensor **220** may be used alone or in combination with other sensors, and depending on the type of sensor **220** used, sensor **220** may also be mounted alone or in multiples. In an exemplary embodiment of the present invention, sensor **220** is front mounted so as to provide a wide sensor field of view (FOV) covering a minimum turn radius of ten (10) meters. Sensor **220** may also be used in some embodiments of system **210** to gather additional information useful to controller **222** in determining the threat of the object to vehicle **200** and the appropriate actions to carry out. This additional information includes the target angle of the object relative to vehicle **200** and the yaw rate of the object relative to vehicle **200**. In other embodiments of system **210**, sensors other than sensor **220** may be provided to measure both the target angle and the yaw rate of the object (i.e., target).

Controller **222** may be a microprocessor-based controller such as a computer having a central processing unit, random

access and/or read-only memory, and associated input and output busses. Controller **222** may be a portion of a main control unit such as vehicle's **200** main controller, or controller **222** may be a stand-alone controller. Controller **222** contains logic for enabling vehicle **200** to reduce its speed in a turn as well as to ignore objects positioned outside of a specific zone area, as will be described in further detail below with regards to FIGS. **3** and **4**.

FIGS. **3** and **4** will now be used in conjunction to describe the method and system of the present invention. Shown in FIG. **3** is vehicle **302** implementing system **210** (FIG. **2**) of the present invention. Vehicle **302** is shown in FIG. **3** at T**1**, T**2**, T**3** and T**4**. At T**1**, vehicle **302** is displayed traveling at a cruise speed in the direction of arrow **309** on road **304**. As vehicle **302** enters the turn at T**2**, controller **222** executes the logic steps illustrated in FIG. **4**. In an exemplary embodiment of system **210**, controller **222** stores the logic steps in memory as instructions to be executed by a processor. As indicated by steps **402-408**, controller **222** continuously monitors vehicle's **302** speed, lateral acceleration and yaw rate, each of which is provided to controller **222** as signals from sensors **215**, **216**, **218** (FIG. **2**). At step **402**, controller **222** obtains and stores vehicle's **302** lateral acceleration data, yaw rate data and vehicle speed data. At step **404**, controller **222** uses a time lag filter to filter the raw lateral acceleration, yaw rate and vehicle speed data, and at step **406**, controller **222** processes this filtered data.

Charted in FIG. **5** is the lateral acceleration of a vehicle in a turn versus the time it takes for the vehicle to complete the turn. The X axis denotes the duration of time it takes the vehicle to complete the turn. The Y axis denotes the lateral acceleration of the vehicle during the turn. The actual path of a vehicle in the turn is illustrated as curve **500**. Curve **500** exhibits the path that a vehicle follows in a turn. Curve **500** may be broken into three (3) sections—entry section **502**, middle section **504** and exit section **506**. At entry section **502** of turn **500**, a vehicle enters the turn. At midsection **504** of turn **500**, the vehicle completes the middle of the turn, and at exit section **506**, the vehicle completes the turn.

Controller **222** (FIG. **2**) may contain logic enabling it to use known characteristics of curve **500** to predict not only whether vehicle **302** is in a turn, but also to determine the position in which vehicle **302** is located in the turn, e.g., in the entry of a turn, in the middle of a turn, or in the exit of a turn. Curve **520** depicts a vehicle's lateral acceleration during the turn illustrated by curve **500**. At entry section **522** of curve **520**, the vehicle's lateral acceleration increases from zero (0) Gs to about 0.15 Gs at a steady rate. At midsection **504** of curve **520**, the lateral acceleration of the vehicle increases less over time and, when charted, has close to a constant curve. The lateral acceleration of the vehicle reaches its maximum value, 0.20 Gs, during midsection **524** of curve **520**. At exit section **526**, the lateral acceleration becomes nearly constant before decreasing back to zero (0) as the turn is completed. Based on curve **520** or other curves derived by the performance of testing, the following characteristics of a vehicle's lateral acceleration in a turn may be derived: 1) in the entry of a turn, the lateral acceleration of a vehicle is likely to rapidly increase from zero (0) Gs over time; 2) in the middle of a turn, the lateral acceleration of a vehicle is likely to show a constant increase before reaching a maximum value; and 3) in the exit of a turn, the lateral acceleration of a vehicle is likely to remain steady for a short period of time before decreasing. These characteristics may be used to program controller **222** both to deduce when a vehicle is in a turning situation and to determine at what position the vehicle is in within the turn.

Controller **222** also uses other data obtained from vehicle **302** to predict whether vehicle **302** is in a turn. This data includes vehicle's **302** yaw rate, which is obtained from yaw rate sensor **218**; vehicle's **302** yaw rate of change, which controller **222** calculates based on the yaw rate; and vehicle's **302** speed, which is obtained from vehicle speed sensor **215**. Yaw rate basically indicates that vehicle **302** is turning on the axis that runs vertically through the center of the vehicle. Vehicle speed data may be combined with lateral acceleration data to indicate the radius of curvature (ROC) or a road, i.e., how tight the turn is.

Referring back to FIGS. **3** and **4**, if controller **222** determines at step **408** that vehicle **302** is not turning, then controller **222** continues to monitor vehicle's **302** lateral acceleration, yaw rate and vehicle speed by obtaining lateral acceleration, yaw rate and vehicle speed data at step **402**. However, if controller **222** determines that vehicle **302** is turning, at step **410** controller **222** determines the position of vehicle **302** in the turn.

As explained above, controller **222** determines vehicle's **302** position within the turn by using programmed instructions that recognize patterns exhibited in lateral acceleration data when a vehicle is in the entry of a turn, in the middle of a turn, or exiting a turn. After controller **222** determines at step **410** where in turn **306** vehicle **302** is positioned, controller **222** then instructs braking system **212** at step **412** to preemptively reduce vehicle's **302** speed so that vehicle's **302** lateral acceleration speed is reduced o a predetermined maximum limit according to vehicle's **302** position in the turn. For example, vehicle **302** may have been set at a cruise speed of fifty (50) miles per hour (MPH) at T**2**. However, controller **222** may contain program instructions that indicate that when vehicle **302** is in the entry of a turn, vehicle's **302** speed should be reduced inversely as the ROC of the turn is reduced. For the same speed, a tighter turn increases the lateral acceleration. For a constant curve, an increase in speed increases the lateral acceleration. By estimating the ROC continuously, when the combination of vehicle's **302** speed and the turn's ROC exceeds the predetermined maximum lateral acceleration limit, controller **222** reduces the speed of vehicle **302**. The formula to find lateral acceleration is $LA=v^2/ROC$ (where LA is lateral acceleration and v is speed), so both speed and ROC affect lateral acceleration.

Upon reducing vehicle's **302** speed, controller **222** may use vehicle's **302** lateral acceleration, yaw rate, yaw rate of change and speed data to estimate the path of vehicle **302** in turn **306** at step **414**. Path estimation is a projection of where vehicle **302** will be at the next sample time. Vehicle's **302** path estimation is a vector whose longitudinal component is based on vehicle's **302** current speed plus the change in vehicle's **302** speed (delta speed). The angle component of vehicle's **302** path estimation is based on vehicle's **302** lateral acceleration, lateral acceleration rate of change, yaw rate and yaw rate of change. The net result is an estimate of the new position of vehicle **302** at time zero (0) plus the change in time (delta time). Referring to FIG. **3**, the projected path of vehicle **302** in turn **306** is marked by boundaries **308***a*, **308***b*. Controller **222** does not instruct braking system **212** to brake or reduce vehicle's **302** speed in turn **306** when an object detected by sensor **220** (FIG. **2**) is outside of projected path boundaries **308***a*, **308***b*. Further, in the case that the projected path of vehicle **302** is not accurate and boundaries **308***a*, **308***b* are incorrectly determined, controller **222** may also determine a safety zone outside of path boundaries **308***a*, **308***b*. The safety zone, bounded by safety zone boundaries **310***a*, **310***b*, is similar to boundaries **308***a*, **308***b* in that controller **222** does not instruct braking system **212** to brake or reduce

vehicle's **302** speed based upon sensor's **220** detection of an object outside of safety zone boundaries **310***a*, **310***b*.

After controller projects the path of vehicle **302** at step **414**, controller **222** obtains sensor data from sensor **220** at step **416** to determine whether stationary object **310** has been detected. As stated above, in-path indicator **303** depicts what, if anything, is detected by sensor **220** as being in the path of vehicle **302**. As vehicle **302** enters turn **306**, in-path indicator **303** highlights stopped vehicle **302**, thus indicating at step **418** that vehicle's sensor **220** detects vehicle **302** as being in vehicle's **302** path. If sensor **220** does not detect target **310**, then controller **222** re-executes the logic steps of FIG. **4** beginning at step **402**.

Upon detecting target **310**, controller **222** verifies at step **420** that stopped vehicle **302** is valid by subjecting target **310** to persistence filtering. The persistence filtering includes using vehicle's **302** yaw rate, yaw rate of change, speed, range (i.e., signal corresponding to a distance between vehicle **302** and target **310**), range rate (i.e., signal corresponding to a rate that the distance between vehicle **302** and target **310** is changing), the angle of target **310** and the ROC of turn **306** to verify target **310**. Target **310** has a range rate equal to but opposite vehicle's **302** speed. By subtracting the range and angle data from vehicle's **302** speed, controller **222** can determine the actual speed and location of target **310**. If the range decreases and the range rate changes inversely to vehicle's **302** delta speed, then target **310** is stationary. If controller **222** determines that target **310** is stationary multiple times, then target **310** is considered to be verified. If target **310** is not directly in front of vehicle **302**, e.g., in a curve, then controller **222** performs the same verification test using vector geometry.

When controller **222** has verified that stopped vehicle **302** is a valid target, controller **222** next determines at step **422** whether vehicle **302** out-of-path. Because vehicle **302** is neither within projected path boundaries **308***a*, **308***b* nor within safety zone boundaries **310***a*, **310***b*, controller **222** determines that vehicle **302** is out-of-path. Accordingly, whereas a prior art ACC or ACC stop-and-go system would cause vehicle **302** to reduce its speed because of detected vehicle **302**, controller **222** eliminates system's **210** braking system at step **424** because stopped vehicle **302** is outside of both projected path boundaries **308***a*, **308***b* and safety zone boundaries **310***a*, **310***b*.

A similar situation is presented at T**3**. Controller **222** determines at step **410** that vehicle **302** is midway through turn **306** and adjusts vehicle's **302** speed according to programmed instructions that provide a predetermined lateral acceleration limit for vehicle **302** midway through its turn. After projecting vehicle's **302** path at step **414**, controller **222** then obtains sensor signal data from sensor **220** at step **416**. In-path indicator **303** highlights a corner of target **312**, thus indicating that target **312** has been detected at step **418**. Once controller **222** verifies at step **420** that target **312** is a valid target, controller **222** determines at step **422** whether target **312** is out-of-path. Since target **312** is positioned outside of both projected path boundaries **308***a*, **308***b* and safety zone boundaries **310***a*, **310***b*, while prior art ACC or ACC stop-and-go systems would have caused vehicle **302** to once again reduce its speed due to the detection of target **312** during turn **306**, inventive system **210** does not instruct braking system **212** to brake or otherwise reduce vehicle's **302** speed because target **312** is out-of-path. If controller **222** had determined that target **312** was in path, it would have instructed braking system **212** to initiate its brake routine.

While this invention has been described as having an exemplary design, the present invention may be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

We claim:

1. A method of controlling a vehicle having an adaptive cruise control system capable of controlling a vehicle speed and obtaining a vehicle lateral acceleration, said method comprising the steps of:

measuring a lateral acceleration from a lateral acceleration sensor;

detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration;

determining when the vehicle is in a turn based on the detected change in the vehicle lateral acceleration; and

if a vehicle is in a turn, reducing the vehicle speed according to the determination that the vehicle is in the turn and the detected change in the vehicle lateral acceleration.

2. The method of claim **1** wherein said step of determining includes steps of

measuring the vehicle speed;

measuring a vehicle yaw rate; and

measuring a rate of change in the vehicle yaw rate.

3. The method of claim **2** wherein said step of determining further includes a step of utilizing speed data corresponding to the vehicle speed, yaw rate data corresponding to the vehicle yaw rate, and yaw rate of change data corresponding to the race of change in the vehicle yaw rate.

4. The method of claim **1** further comprising a step of determining the vehicle's position within the turn.

5. The method of claim **1** wherein said step of reducing the vehicle speed includes a step of reducing the speed if the vehicle lateral acceleration exceeds a predetermined limit.

6. A method of controlling a vehicle, said method comprising the steps of:

operating the vehicle in an adaptive cruise control mode such that the vehicle is traveling at a vehicle speed;

measuring a lateral acceleration from a lateral acceleration sensor;

detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration;

determining the vehicle path based on the detected change in the vehicle lateral acceleration;

monitoring for objects;

detecting a location of an object;

determining whether the location of an object is within the vehicle path; and

when the vehicle is determined to be in the turn, reducing the vehicle speed according to the determination that the vehicle is in the turn and the location of the object.

7. The method of claim **6** wherein said step of determining whether the vehicle is in a turn includes steps of

measuring the vehicle speed;

measuring a vehicle yaw rate; and

measuring a change in the vehicle yaw rate.

8. The method of claim **6** further comprising a step of determining the vehicle's position within the turn.

9. The method of claim **8** wherein said step of reducing the vehicle speed includes a step of reducing the vehicle speed if the vehicle lateral acceleration exceeds a predetermined limit.

10. The method of claim **6** wherein said step of detecting an object includes steps of:

measuring object range;

measuring object range rate, said object range rate corresponding to a rate that the distance between the vehicle and the object is changing;

measuring object angle; and

determining the radius of curvature of the vehicle's path.

11. The method claim of **10** wherein said step of monitoring includes a step of determining whether the detected object is in the vehicle's path.

12. The method of claim **11** wherein said step of monitoring includes a step of verifying that the object is in the vehicles path.

* * * * *

EXHIBIT 2

US007925416B2

(12) **United States Patent**
Perisho, Jr. et al.

(10) **Patent No.: US 7,925,416 B2**
(45) **Date of Patent: Apr. 12, 2011**

(54) **AUTOMATIC LATERAL ACCELERATION LIMITING AND NON THREAT TARGET REJECTION**

(75) Inventors: **Robert A. Perisho, Jr.**, Russiaville, IN (US); **Jeremy S. Greene**, Fishers, IN (US)

(73) Assignee: **Delphi Technologies, Inc.**, Troy, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 122 days.

(21) Appl. No.: **12/371,792**

(22) Filed: **Feb. 16, 2009**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
B60K 31/00 (2006.01)
G06F 19/00 (2006.01)

(52) **U.S. Cl.** **701/96**; 701/78; 701/93; 180/170

(58) **Field of Classification Search** 701/96, 701/72, 78, 301; 180/170
See application file for complete search history.

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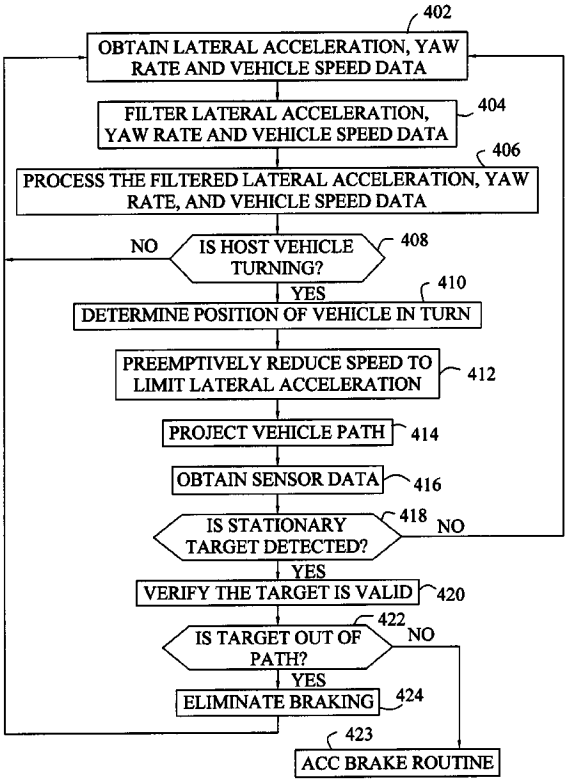
Primary Examiner — Tan Q Nguyen
(74) *Attorney, Agent, or Firm* — Thomas N. Tworney

(57) **ABSTRACT**

The present invention provides a system and method for enabling a vehicle having adaptive cruise control to reduce its speed in a turn according to the vehicle's position within the turn as well as ignoring objects detected during the turn that are not in the vehicle's path. The method of the present invention includes the steps of operating the vehicle in an adaptive cruise control mode such that the vehicle is traveling at a set speed; determining whether the vehicle is in a turn in the vehicle's path by detecting change in the vehicle's lateral acceleration; and when the vehicle is determined to be in the turn, reducing the vehicle's speed according to the vehicle's position in the turn, monitoring for objects and maintaining the vehicle's speed if an object is positioned out of the path of the vehicle.

14 Claims, 5 Drawing Sheets



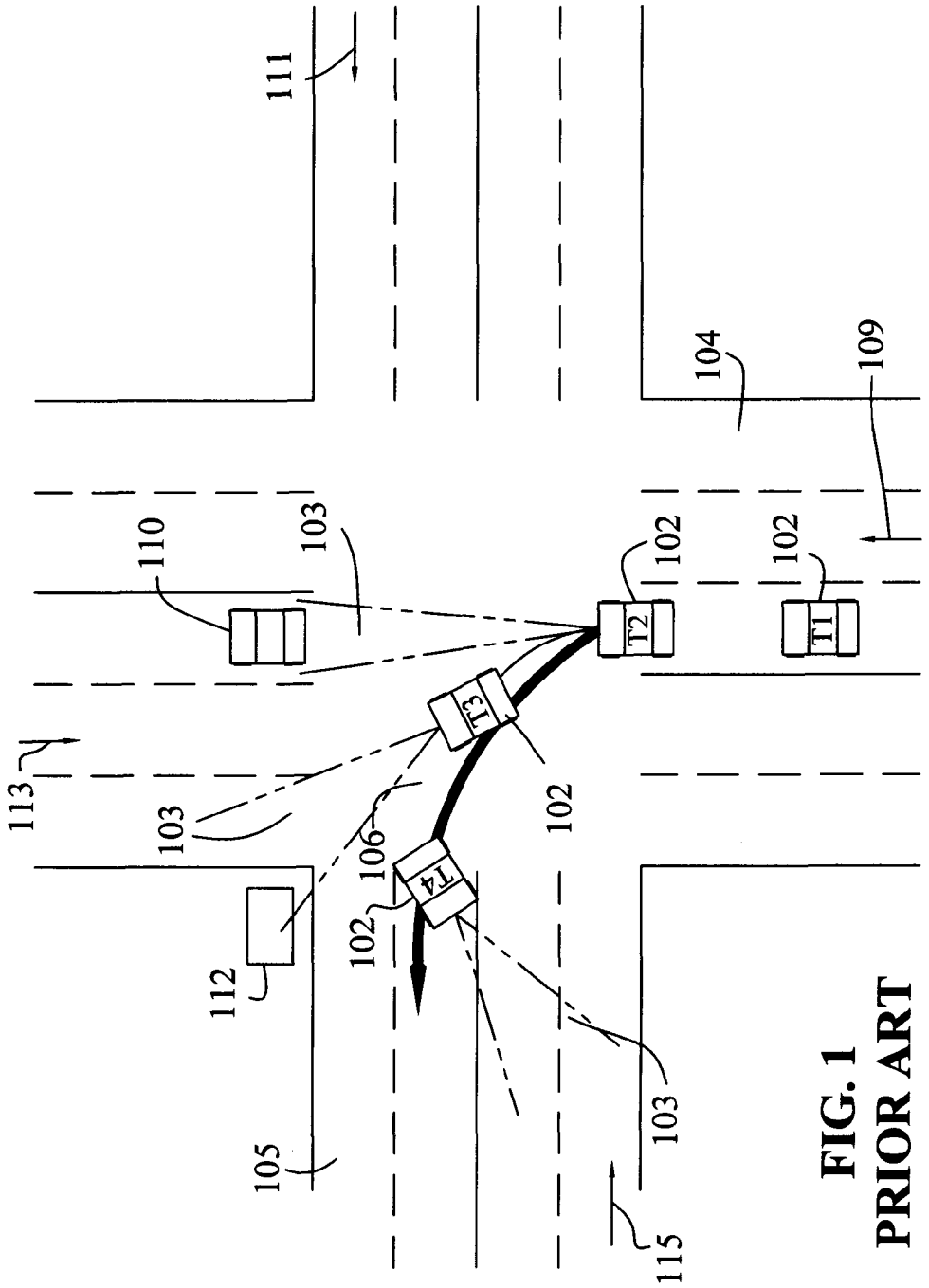


FIG. 1
PRIOR ART

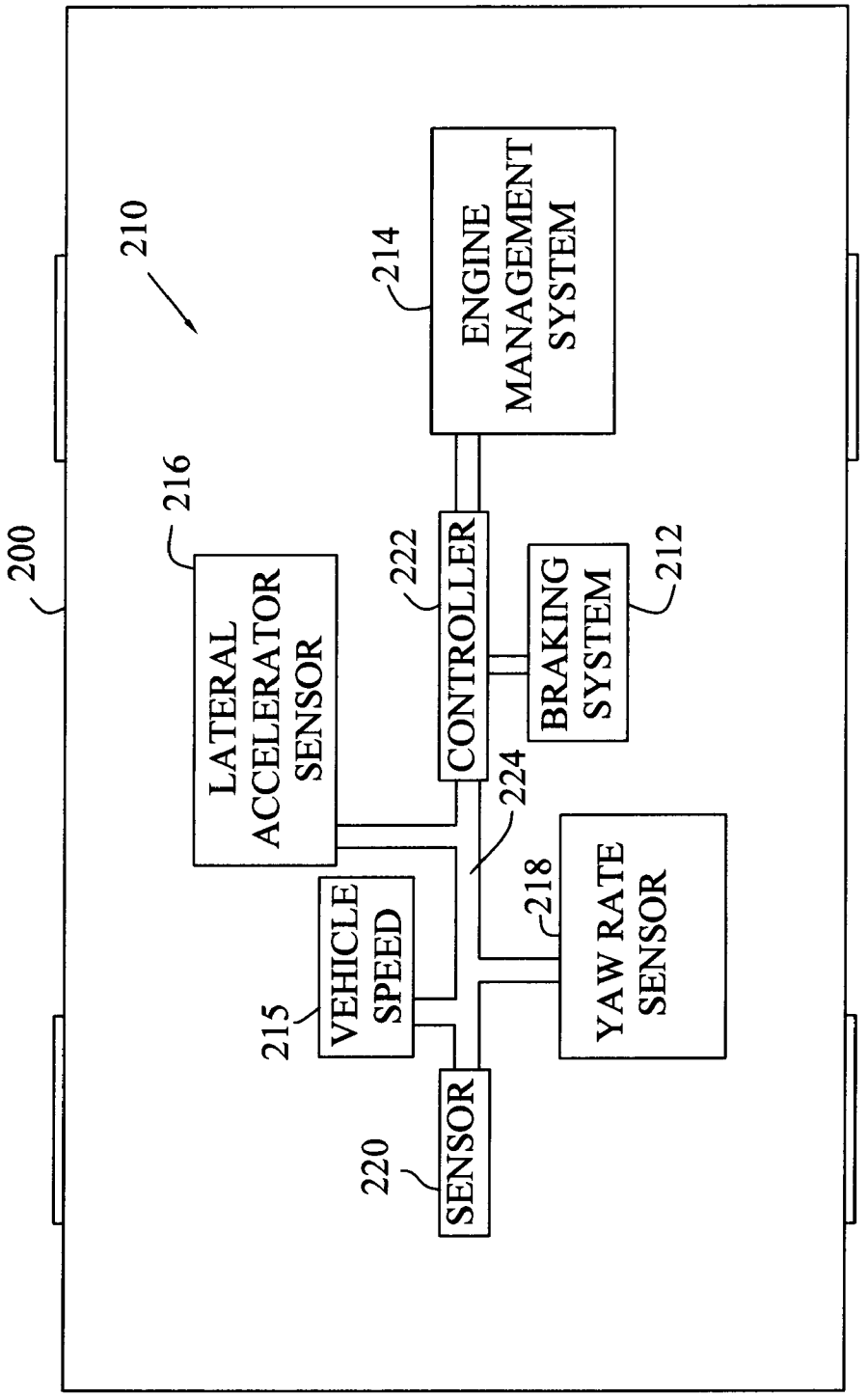

200
210
214
ENGINE MANAGEMENT SYSTEM
216
LATERAL ACCELERATOR SENSOR
222
CONTROLLER
212
BRAKING SYSTEM
224
218
YAW RATE SENSOR
215
VEHICLE SPEED
220
SENSOR

FIG. 2

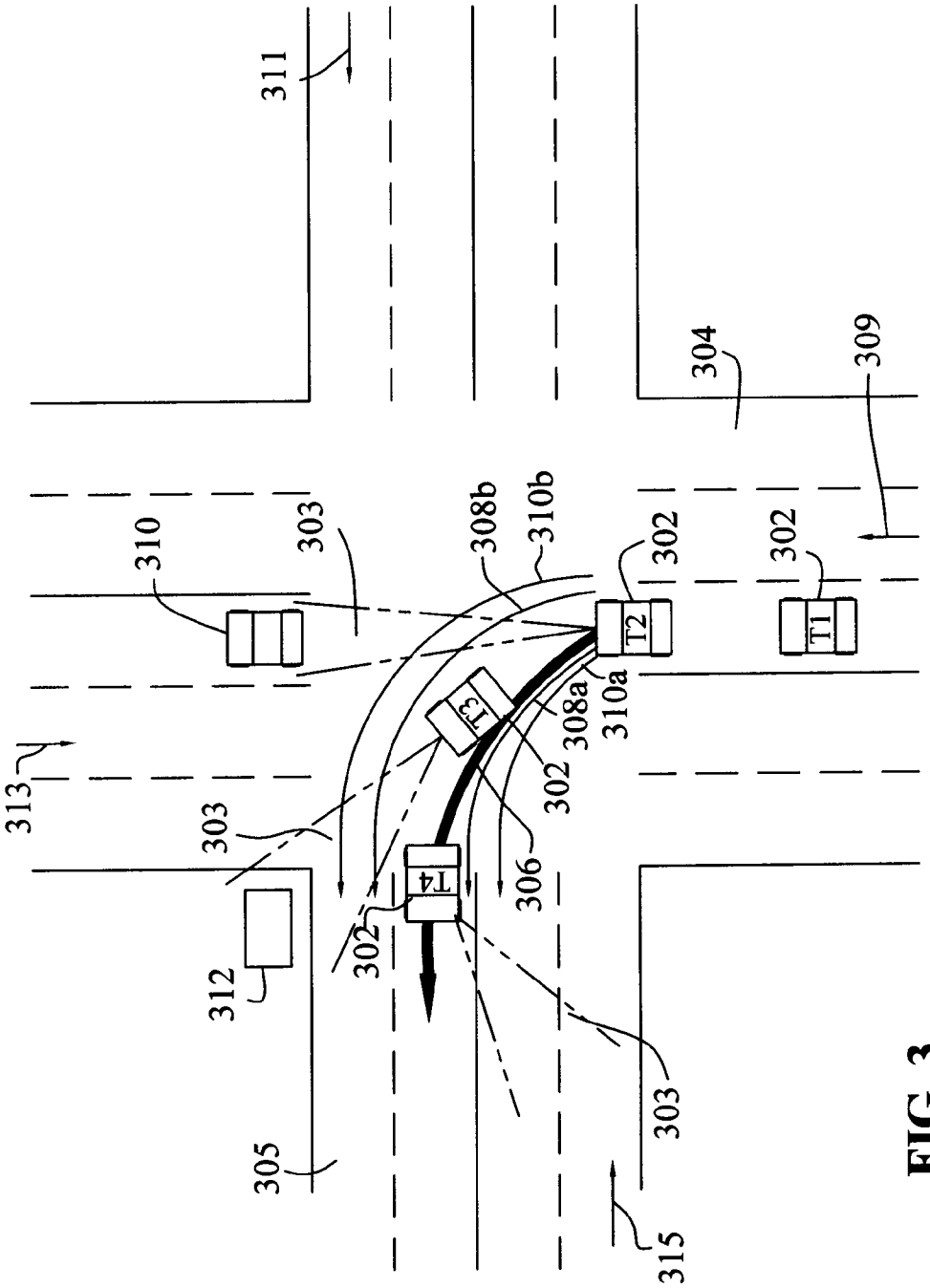

311
304
309
310
303
308b
310b
302
302
T2
T1
T3
308a
310a
313
303
302
306
T4
302
312
303
305
315

FIG. 3

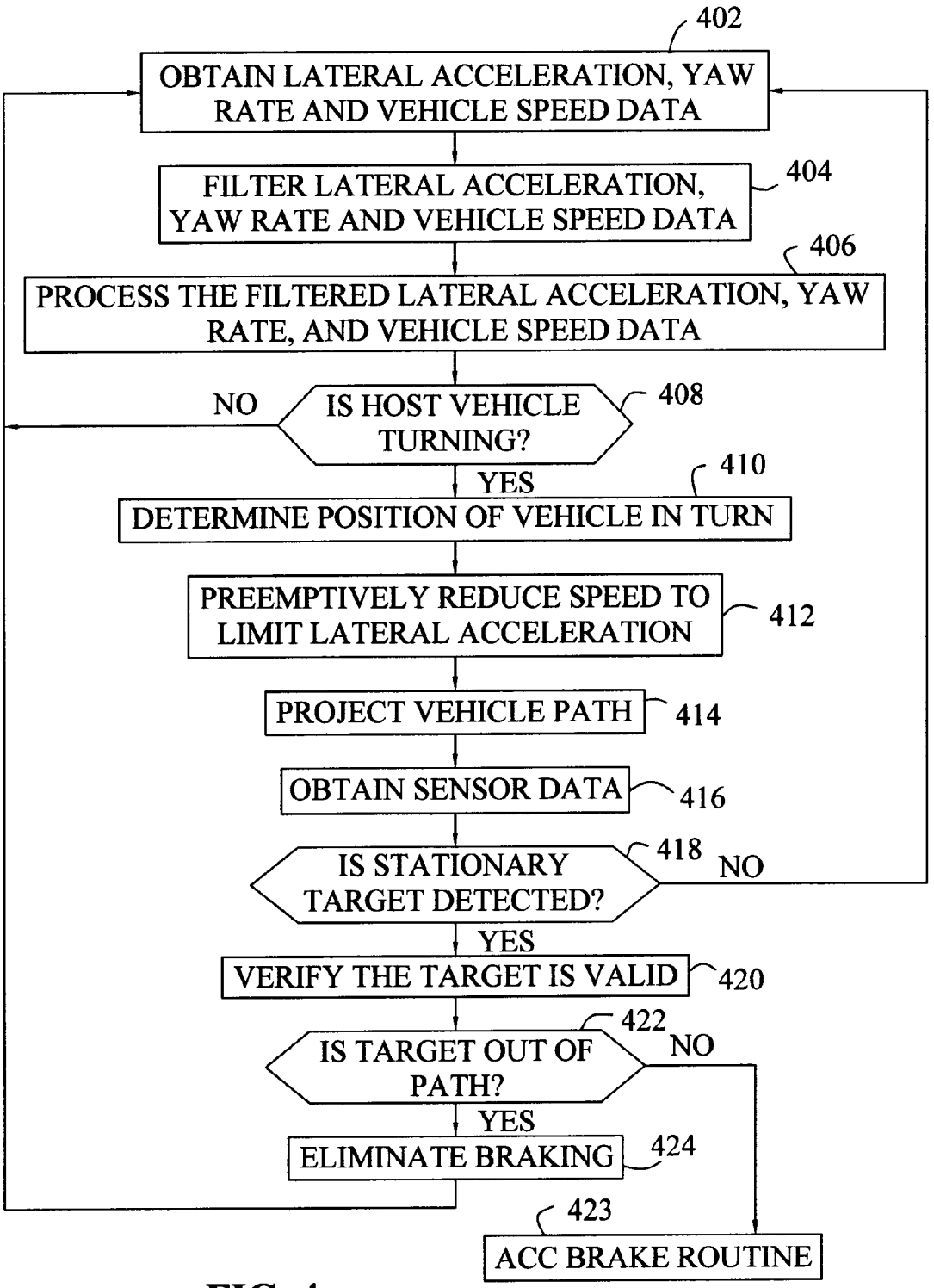

402
OBTAIN LATERAL ACCELERATION, YAW RATE AND VEHICLE SPEED DATA
404
FILTER LATERAL ACCELERATION, YAW RATE AND VEHICLE SPEED DATA
406
PROCESS THE FILTERED LATERAL ACCELERATION, YAW RATE, AND VEHICLE SPEED DATA
NO
IS HOST VEHICLE TURNING?
408
YES
410
DETERMINE POSITION OF VEHICLE IN TURN
PREEMPTIVELY REDUCE SPEED TO LIMIT LATERAL ACCELERATION
412
PROJECT VEHICLE PATH
414
OBTAIN SENSOR DATA
416
IS STATIONARY TARGET DETECTED?
418
NO
YES
VERIFY THE TARGET IS VALID
420
IS TARGET OUT OF PATH?
422
NO
YES
ELIMINATE BRAKING
424
423
ACC BRAKE ROUTINE

FIG. 4

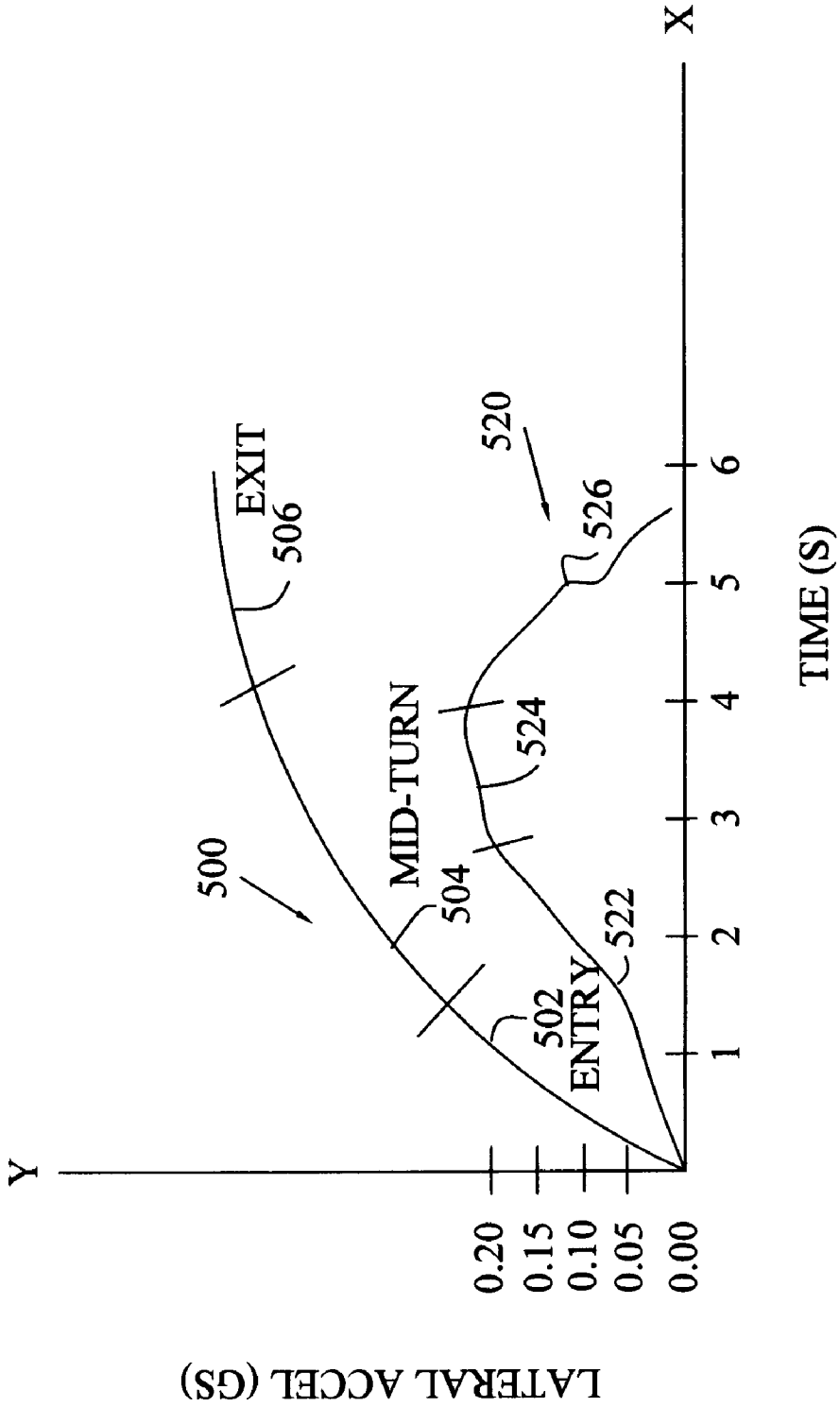

LATERAL ACCEL (GS)
0.20
0.15
0.10
0.05
0.00
Y
X
TIME (S)
1
2
3
4
5
6
500
EXIT
506
MID-TURN
504
ENTRY
502
520
522
524
526

FIG. 5

AUTOMATIC LATERAL ACCELERATION LIMITING AND NON THREAT TARGET REJECTION

This application is a division of U.S. patent application Ser. No. 10/804,745, filed Mar. 19, 2004.

TECHNICAL BACKGROUND

The present invention generally relates to a vehicle which contains an adaptive cruise control ("ACC") system. Specifically, this invention relates to a method and system for controlling a vehicle having an ACC system.

BACKGROUND OF THE INVENTION

Cruise control systems for automotive vehicles are widely known in the art. In basic systems, the driver of a vehicle attains a desired vehicle speed and initiates the cruise control system at a set speed. The vehicle then travels at the set speed until the driver applies the brakes or turns off the system.

Advances in vehicle electronics and sensory technology have provided for cruise control systems that go a step beyond the system described above. ACC systems are not only capable of maintaining a set vehicle speed, but they also include object sensing technology, such as radar, laser, or other types of sensing systems, that will detect a vehicle in the path of the vehicle that contains the ACC (or other form of cruise control) system (i.e., "host vehicle"). Accordingly, ACC is an enhancement to traditional cruise control by automatically adjusting a set speed to allow a vehicle to adapt to moving traffic.

Under normal driving conditions the ACC system is engaged with a set speed equal to a maximum speed that is desired by the vehicle driver, and the ACC system operates in a conventional cruise control mode. If the host vehicle is following too closely behind a vehicle in the path of the host vehicle ("in-path vehicle"), the ACC system automatically reduces the host vehicle's speed by reducing the throttle and/or applying the brakes to obtain a predetermined safe following interval. When the in-path vehicle approaches slow traffic and the ACC system reduces the speed of the host vehicle below a minimum speed for ACC operation, the ACC automatically disengages and the driver manually follows slower in-path vehicles in the slow traffic. When the slow traffic is no longer in front of the host-vehicle, the driver must manually accelerate the host vehicle to a speed above the minimum speed for ACC operation before the ACC system is able to resume acceleration to the set speed. In typical ACC systems, objects moving at approximately 30% (thirty percent) or less of the host vehicle's speed are disregarded for braking purposes (i.e., the vehicle's brakes are not applied, the throttle is not reduced, and no other action is taken to slow down the host vehicle).

Traditional ACC systems were designed to enable a vehicle to react to moving targets presented by normal traffic conditions under extended cruise control operation and when the vehicle is traveling at speeds above forty (40) kilometers per hour (KPH). "Stop-and-go" ACC systems are an enhanced form of ACC that overcome some of the shortcomings of ACC systems. Stop-and-go ACC systems enable the host vehicle to follow an in-path vehicle in slower traffic conditions such as stop and go traffic. Therefore, while ACC stop-and-go systems improve the performance of traditional ACC systems, both ACC and ACC stop-and-go systems still provide problems for the driver of the vehicle.

A first problem presented by ACC and ACC stop-and-go systems is that because there may be an abundance of out-of-path stationary targets encountered by a vehicle during a turn, braking for each of these targets can cause driver discomfort. Current ACC and ACC stop-and-go systems are not capable of disregarding the stationary targets not within the vehicle's path (i.e., "out-of-path" targets). An example is shown in FIG. **1**, in which vehicle **102** utilizes a prior art ACC or ACC stop-and-go system. Vehicle **102** is shown at three (4) different times—time one ("T**1**"), time two ("T**2**"), time three ("T**3**") and time four ("T**4**"). At T**1**, vehicle **102** is shown traveling in the direction of arrow **109** at a cruise speed on road **104**. In-path indicator **103** highlights objects that are in the path of vehicle **102** as vehicle **102** travels. As vehicle **102** enters a left turn at T**2**, which is illustrated by arrow **106** ("turn **106**"), in-path indicator **103** illustrates that stationary object **110** is within vehicle's **102** path. Object **110** may be any stationary object, for example, a traffic light, a stopped vehicle, construction equipment, a person, an animal, a sign, or any other object. Since object **110** is in the path of vehicle **102**, the ACC or ACC stop-and-go system contained by vehicle **102** appropriately instructs vehicle **102** to either brake or reduce its speed in some fashion. This situation, however, is an unnecessary braking situation because vehicle **110** is not a threat to vehicle **102** at T**2**.

As vehicle **102** is midway through turn **106** at T**3**, vehicle **102** detects stationary object **112**, as highlighted by in-path indicator **103**. Because object **112** is in the path of vehicle **102**, vehicle's **102** ACC or ACC stop-and-go system brakes and reduces vehicle's **102** speed. Object **112**, however, like object **110**, is non-threatening to vehicle **102**. Therefore, in making turn **106**, vehicle's **102** ACC or ACC stop-and-go system unnecessarily reduces the speed of vehicle **102**. This excessive braking may annoy and provide discomfort to the driver of vehicle **102**.

Another problem presented by current ACC and ACC stop-and-go systems is that the systems' maintenance of a set cruise speed in turning situations may cause excessive lateral acceleration and the possible loss of control of the host vehicle. An example is shown in FIG. **1**. As vehicle **102** enters turn **106**, maintaining the cruise speed may cause excessive lateral acceleration. Vehicle **102**, shown at T**4**, illustrates how the excessive lateral acceleration can cause vehicle's **102** tail to careen out of vehicle's **102** desired turn **106**. Excessive lateral acceleration such as that described in this example may result in injury to the driver of vehicle **102** as well as to nearby vehicle drivers or pedestrians.

SUMMARY OF THE INVENTION

The method and system of the present invention provides smooth vehicle control in turning situations both by limiting lateral acceleration during the vehicle turn and by eliminating braking for out-of-path targets.

In one form of the present invention, a method of controlling a vehicle having an adaptive cruise control system capable of obtaining the vehicle's lateral acceleration is provided, the method including the steps of determining when the vehicle is in a turn based on a detected change in the vehicle's lateral acceleration; and reducing the vehicle's speed according to the vehicle's position in the turn.

In another form of the present invention, a method of controlling a vehicle is provided, the method including the steps of operating the vehicle in an adaptive cruise control mode such that the vehicle is traveling at a set speed; determining whether the vehicle is in a turn in the vehicle's path by detecting change in the vehicle's lateral acceleration; and

when the vehicle is determined to be in the turn, reducing the vehicle's speed according to the vehicle's position in the turn, monitoring for objects and maintaining the vehicle's speed if an object is positioned out of the path of the vehicle.

In still another form, the present invention provides a method of controlling a vehicle operating in an adaptive cruise control mode and traveling at a set speed, the method including the steps of estimating a path for the vehicle in a turn; associating the vehicle path with a first safety zone area, the first safety zone area including the turn; and reducing the vehicle's speed when a detected object is determined to be in the first safety zone area and maintaining the vehicle's speed when a detected object is determined to be outside of the first safety zone area.

In yet another form of the present invention, a system is provided for use in controlling a vehicle, the system including an adaptive cruise control system; a controller in communication with the adaptive cruise control system and capable of determining when the vehicle is in a turn, the controller operative to reduce the vehicle's speed according to the vehicle's position in the turn; at least one lateral acceleration sensor for generating a signal corresponding to the vehicle's lateral acceleration, the lateral acceleration sensor in electrical communication with the controller and operative to detect a change in the vehicle's lateral acceleration; and at least one object detection sensor for detecting an object in the path of the vehicle during the turn, the object detection sensor in electrical communication with the controller, wherein the controller includes control logic operative to determine whether the object is in the vehicle's path during the turn and ignoring the object for braking purposes when the object is not determined to be in the vehicle's path.

In another form of the present invention, a method of controlling a vehicle in a turn is provided, the method including the steps of measuring the vehicle's speed; measuring the vehicle's lateral acceleration; estimating the radius of curvature of the vehicle's path based on the vehicle's speed and lateral acceleration; and when the combination of the vehicle's speed and the vehicle path's radius of curvature exceeds a predetermined maximum lateral acceleration limit, reducing the vehicle's speed.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and objects of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a diagrammatic view of a vehicle having a prior art ACC or ACC stop-and-go ACC system in a turn situation;

FIG. **2** is a schematic view of a vehicle including the system of the present invention;

FIG. **3** is a diagrammatic view of a vehicle having the inventive system in a turn situation;

FIG. **4** is a illustrative view of the method of the present invention; and

FIG. **5** charts the lateral acceleration of a vehicle in a turn situation.

Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of the present invention, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the present invention. The exemplifications set out herein illustrate embodiments of the invention in several forms and such exemplification is not to be construed as limiting the scope of the invention in any manner.

DESCRIPTION OF INVENTION

The embodiments disclosed below are not intended to be exhaustive or limit the invention to the precise forms disclosed in the following detailed description. Rather, the embodiments are chosen and described so that others skilled in the art may utilize their teachings.

FIG. **2** shows the inventive stop-and-go adaptive cruise control (ACC) system **210** of the present invention. While system **210** is described within the context of an ACC stop-and-go system, it is contemplated that system **210** may also be used in a traditional ACC system. System **210** is implemented in host vehicle **200** that has braking system **212** and engine management system **214**. System **210** includes vehicle speed sensor **215** for measuring vehicle's **200** speed, lateral acceleration sensor **216** for measuring the acceleration of vehicle **200** in the direction of vehicle's **200** lateral axis in a turn, and yaw rate sensor **218** for measuring the rate that vehicle **200** is rotating about its vertical axis. System **210** also includes sensor **220** for generating a range signal corresponding to a distance between host vehicle **200** and a target, and a target range rate signal corresponding to a rate that the distance between host vehicle **200** and the target is changing. Controller **222** is in electronic communication with sensors **215**, **216**, **218**, **220** over communication bus **224**.

Braking system **212** may include any braking system that is capable of reducing the speed of vehicle **200**. Such braking mechanisms include a transmission controller that is capable of downshifting a transmission of vehicle **200**, a throttle that may be reduced to decrease the speed of vehicle **200**, a brake booster controller equivalent to the vehicle's driver applying the brakes, etc.

Engine management system **214** may include any known vehicle component or system that may be used to adjust the acceleration of vehicle **200**. Such components and/or systems may include a vehicle accelerator, a fuel and air intake control system, or an engine timing controller.

Sensor **220** may include any object detecting sensor known in the art, including a radar sensor (e.g., doppler or microwave radar), a laser radar (LIDAR) sensor, an ultrasonic radar, a forward looking IR (FLIR), a stereo imaging system, or a combination of a radar sensor and a camera system. Sensor **220** functions to detect objects positioned in the path of vehicle **200**. For example, shown in FIGS. **1** and **3**, in-path indicators **103**, **303** depict sensor's **220** capability to detect an object in the path of vehicles **103**, **303**, respectively. Sensor **220** may be used alone or in combination with other sensors, and depending on the type of sensor **220** used, sensor **220** may also be mounted alone or in multiples. In an exemplary embodiment of the present invention, sensor **220** is front mounted so as to provide a wide sensor field of view (FOV) covering a minimum turn radius of ten (10) meters. Sensor **220** may also be used in some embodiments of system **210** to gather additional information useful to controller **222** in determining the threat of the object to vehicle **200** and the appropriate actions to carry out. This additional information includes the target angle of the object relative to vehicle **200** and the yaw rate of the object relative to vehicle **200**. In other embodiments of system **210**, sensors other than sensor **220** may be provided to measure both the target angle and the yaw rate of the object (i.e., target).

Controller **222** may be a microprocessor-based controller such as a computer having a central processing unit, random

access and/or read-only memory, and associated input and output busses. Controller **222** may be a portion of a main control unit such as vehicle's **200** main controller, or controller **222** may be a stand-alone controller. Controller **222** contains logic for enabling vehicle **200** to reduce its speed in a turn as well as to ignore objects positioned outside of a specific safety zone area, as will be described in further detail below with regards to FIGS. **3** and **4**.

FIGS. **3** and **4** will now be used in conjunction to describe the method and system of the present invention. Shown in FIG. **3** is vehicle **302** implementing system **210** (FIG. **2**) of the present invention. Vehicle **302** is shown in FIG. **3** at T**1**, T**2**, T**3** and T**4**. At T**1**, vehicle **302** is displayed traveling at a cruise speed in the direction of arrow **309** on road **304**. As vehicle **302** enters the turn at T**2**, controller **222** executes the logic steps illustrated in FIG. **4**. In an exemplary embodiment of system **210**, controller **222** stores the logic steps in memory as instructions to be executed by a processor. As indicated by steps **402**-**408**, controller **222** continuously monitors vehicle's **302** speed, lateral acceleration and yaw rate, each of which is provided to controller **222** as signals from sensors **215**, **216**, **218** (FIG. **2**). At step **402**, controller **222** obtains and stores vehicle's **302** lateral acceleration data, yaw rate data and vehicle speed data. At step **404**, controller **222** uses a time lag filter to filter the raw lateral acceleration, yaw rate and vehicle speed data, and at step **406**, controller **222** processes this filtered data.

Charted in FIG. **5** is the lateral acceleration of a vehicle in a turn versus the time it takes for the vehicle to complete the turn. The X axis denotes the duration of time it takes the vehicle to complete the turn. The Y axis denotes the lateral acceleration of the vehicle during the turn. The actual path of a vehicle in the turn is illustrated as curve **500**. Curve **500** exhibits the path that a vehicle follows in a turn. Curve **500** may be broken into three (3) sections—entry section **502**, middle section **504** and exit section **506**. At entry section **502** of turn **500**, a vehicle enters the turn. At midsection **504** of turn **500**, the vehicle completes the middle of the turn, and at exit section **506**, the vehicle completes the turn.

Controller **222** (FIG. **2**) may contain logic enabling it to use known characteristics of curve **500** to predict not only whether vehicle **302** is in a turn, but also to determine the position in which vehicle **302** is located in the turn, e.g., in the entry of a turn, in the middle of a turn, or in the exit of a turn. Curve **520** depicts a vehicle's lateral acceleration during the turn illustrated by curve **500**. At entry section **522** of curve **520**, the vehicle's lateral acceleration increases from zero (0) Gs to about 0.15 Gs at a steady rate. At midsection **504** of curve **520**, the lateral acceleration of the vehicle increases less over time and, when charted, has close to a constant curve. The lateral acceleration of the vehicle reaches its maximum value, 0.20 Gs, during midsection **524** of curve **520**. At exit section **526**, the lateral acceleration becomes nearly constant before decreasing back to zero (0) as the turn is completed. Based on curve **520** or other curves derived by the performance of testing, the following characteristics of a vehicle's lateral acceleration in a turn may be derived: 1) in the entry of a turn, the lateral acceleration of a vehicle is likely to rapidly increase from zero (0) Gs over time; 2) in the middle of a turn, the lateral acceleration of a vehicle is likely to show a constant increase before reaching a maximum value; and 3) in the exit of a turn, the lateral acceleration of a vehicle is likely to remain steady for a short period of time before decreasing. These characteristics may be used to program controller **222** both to deduce when a vehicle is in a turning situation and to determine at what position the vehicle is in within the turn.

Controller **222** also uses other data obtained from vehicle **302** to predict whether vehicle **302** is in a turn. This data includes vehicle's **302** yaw rate, which is obtained from yaw rate sensor **218**; vehicle's **302** yaw rate of change, which controller **222** calculates based on the yaw rate; and vehicle's **302** speed, which is obtained from vehicle speed sensor **215**. Yaw rate basically indicates that vehicle **302** is turning on the axis that runs vertically through the center of the vehicle. Vehicle speed data may be combined with lateral acceleration data to indicate the radius of curvature (ROC) or a road, i.e., how tight the turn is.

Referring back to FIGS. **3** and **4**, if controller **222** determines at step **408** that vehicle **302** is not turning, then controller **222** continues to monitor vehicle's **302** lateral acceleration, yaw rate and vehicle speed by obtaining lateral acceleration, yaw rate and vehicle speed data at step **402**. However, if controller **222** determines that vehicle **302** is turning, at step **410** controller **222** determines the position of vehicle **302** in the turn.

As explained above, controller **222** determines vehicle's **302** position within the turn by using programmed instructions that recognize patterns exhibited in lateral acceleration data when a vehicle is in the entry of a turn, in the middle of a turn, or exiting a turn. After controller **222** determines at step **410** where in turn **306** vehicle **302** is positioned, controller **222** then instructs braking system **212** at step **412** to preemptively reduce vehicle's **302** speed so that vehicle's **302** lateral acceleration speed is reduced to a predetermined maximum limit according to vehicle's **302** position in the turn. For example, vehicle **302** may have been set at a cruise speed of fifty (50) miles per hour (MPH) at T**2**. However, controller **222** may contain program instructions that indicate that when vehicle **302** is in the entry of a turn, vehicle's **302** speed should be reduced inversely as the ROC of the turn is reduced. For the same speed, a tighter turn increases the lateral acceleration. For a constant curve, an increase in speed increases the lateral acceleration. By estimating the ROC continuously, when the combination of vehicle's **302** speed and the turn's ROC exceeds the predetermined maximum lateral acceleration limit, controller **222** reduces the speed of vehicle **302** The formula to find lateral acceleration is $LA=v^2/ROC$ (where LA is lateral acceleration and v is speed), so both speed and ROC affect lateral acceleration.

Upon reducing vehicle's **302** speed, controller **222** may use vehicle's **302** lateral acceleration, yaw rate, yaw rate of change and speed data to estimate the path of vehicle **302** in turn **306** at step **414**. Path estimation is a projection of where vehicle **302** will be at the next sample time. Vehicle's **302** path estimation is a vector whose longitudinal component is based on vehicle's **302** current speed plus the change in vehicle's **302** speed (delta speed). The angle component of vehicle's **302** path estimation is based on vehicle's **302** lateral acceleration, lateral acceleration rate of change, yaw rate and yaw rate of change. The net result is an estimate of the new position of vehicle **302** at time zero (0) plus the change in time (delta time). Referring to FIG. **3**, the projected path of vehicle **302** in turn **306** is marked by boundaries **308***a*, **308***b*. Controller **222** does not instruct braking system **212** to brake or reduce vehicle's **302** speed in turn **306** when an object detected by sensor **220** (FIG. **2**) is outside of projected path boundaries **308***a*, **308***b*. Further, in the case that the projected path of vehicle **302** is not accurate and boundaries **308***a*, **308***b* are incorrectly determined, controller **222** may also determine a safety zone outside of path boundaries **308***a*, **308***b*. The safety zone, bounded by safety zone boundaries **310***a*, **310***b*, is similar to boundaries **308***a*, **308***b* in that controller **222** does not instruct braking system **212** to brake or reduce

vehicle's **302** speed based upon sensor's **220** detection of an object outside of safety zone boundaries **310***a*, **310***b*.

After controller projects the path of vehicle **302** at step **414**, controller **222** obtains sensor data from sensor **220** at step **416** to determine whether stationary object **310** has been detected. As stated above, in-path indicator **303** depicts what, if anything, is detected by sensor **220** as being in the path of vehicle **302**. As vehicle **302** enters turn **306**, in-path indicator **303** highlights stopped vehicle **302**, thus indicating at step **418** that vehicle's sensor **220** detects vehicle **302** as being in vehicle's **302** path. If sensor **220** does not detect target **310**, then controller **222** re-executes the logic steps of FIG. **4** beginning at step **402**.

Upon detecting target **310**, controller **222** verifies at step **420** that stopped vehicle **302** is valid by subjecting target **310** to persistence filtering. The persistence filtering includes using vehicle's **302** yaw rate, yaw rate of change, speed, range (i.e., signal corresponding to a distance between vehicle **302** and target **310**), range rate (i.e., signal corresponding to a rate that the distance between vehicle **302** and target **310** is changing), the angle of target **310** and the ROC of turn **306** to verify target **310**. Target **310** has a range rate equal to but opposite vehicle's **302** speed. By subtracting the range and angle data from vehicle's **302** speed, controller **222** can determine the actual speed and location of target **310**. If the range decreases and the range rate changes inversely to vehicle's **302** delta speed, then target **310** is stationary. If controller **222** determines that target **310** is stationary multiple times, then target **310** is considered to be verified. If target **310** is not directly in front of vehicle **302**, e.g., in a curve, then controller **222** performs the same verification test using vector geometry.

When controller **222** has verified that stopped vehicle **302** is a valid target, controller **222** next determines at step **422** whether vehicle **302** out-of-path. Because vehicle **302** is neither within projected path boundaries **308***a*, **308***b* nor within safety zone boundaries **310***a*, **310***b*, controller **222** determines that vehicle **302** is out-of-path. Accordingly, whereas a prior art ACC or ACC stop-and-go system would cause vehicle **302** to reduce its speed because of detected vehicle **302**, controller **222** eliminates system's **210** braking system at step **424** because stopped vehicle **302** is outside of both projected path boundaries **308***a*, **308***b* and safety zone boundaries **310***a*, **310***b*.

A similar situation is presented at T**3**. Controller **222** determines at step **410** that vehicle **302** is midway through turn **306** and adjusts vehicle's **302** speed according to programmed instructions that provide a predetermined lateral acceleration limit for vehicle **302** midway through its turn. After projecting vehicle's **302** path at step **414**, controller **222** then obtains sensor signal data from sensor **220** at step **416**. In-path indicator **303** highlights a corner of target **312**, thus indicating that target **312** has been detected at step **418**. Once controller **222** verifies at step **420** that target **312** is a valid target, controller **222** determines at step **422** whether target **312** is out-of-path. Since target **312** is positioned outside of both projected path boundaries **308***a*, **308***b* and safety zone boundaries **310***a*, **310***b*, while prior art ACC or ACC stop-and-go systems would have caused vehicle **302** to once again reduce its speed due to the detection of target **312** during turn **306**, inventive system **210** does not instruct braking system **212** to brake or otherwise reduce vehicle's **302** speed because target **312** is out-of-path. If controller **222** had determined that target **312** was in path, it would have instructed braking system **212** to initiate its brake routine.

While this invention has been described as having an exemplary design, the present invention may be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

We claim:

1. A method of controlling a vehicle having an adaptive cruise control system capable of obtaining a vehicle lateral acceleration, said method comprising the steps of:
- determining when the vehicle is in a turn based on a detected change in the vehicle lateral acceleration;
- determining a vehicle path during the turn;
- detecting an object;
- determining whether the object is in the vehicle path during the turn;
- reducing the vehicle speed if the object is determined to be in the vehicle path during the turn; and
- ignoring the object for braking purposes if the object is determined not to be in the vehicle path during the turn.

2. The method of claim **1**, wherein said step of determining when the vehicle is in a turn includes steps of:
- measuring a vehicle speed;
- measuring a vehicle yaw rate; and
- measuring a rate of change in the vehicle yaw rate.

3. The method of claim **2**, wherein said step of determining when the vehicle is in a turn further includes a step of utilizing speed data corresponding to the vehicle speed, yaw rate data corresponding to the vehicle yaw rate, and yaw rate of change data corresponding to the rate of change in the vehicle yaw rate, to calculate lateral acceleration data, said lateral acceleration data corresponding to the vehicle lateral acceleration.

4. The method of claim **3**, wherein said step of determining when the vehicle is in a turn includes a step of filtering the lateral acceleration data to detect a change in the vehicle lateral acceleration.

5. The method of claim **4**, wherein said step of determining when the vehicle is in a turn further includes a step of processing the filtered lateral acceleration data to determine whether the vehicle is turning.

6. The method of claim **1**, wherein said step of reducing the vehicle speed includes a step of reducing the speed when the vehicle lateral acceleration exceeds a predetermined limit.

7. The method of claim **1**, wherein said step of determining whether the object is in the vehicle path during the turn includes steps of:
- measuring an object range;
- measuring an object range rate;
- measuring an object angle in relation to the vehicle; and
- determining a vehicle path radius of curvature.

8. The method of claim **1**, wherein said step of determining whether the object is in the vehicle path includes a step of verifying whether the object is in the vehicle path, said step of verifying including a step of using the yaw rate data, the yaw rate of change data, the speed data, range data corresponding to a distance between the vehicle and the object, range rate data corresponding to a rate that the distance between the vehicle and the object is changing, angle data corresponding to the object angle in relation to the vehicle, and road curvature data corresponding to the vehicle path radius of curvature.

9. The method of claim **1** further comprising a step of measuring the vehicle lateral acceleration.

10. A system for use in controlling a vehicle at a vehicle speed, said system including:
- an adaptive cruise control system;
- a controller in communication with said adaptive cruise control system and capable of determining when the

vehicle is in a turn, said controller operative to reduce the vehicle speed according to a vehicle position in the turn;

at least one lateral acceleration sensor for generating a signal corresponding to a vehicle lateral acceleration, said lateral acceleration sensor in electrical communication with said controller and operative to detect a change in the vehicle lateral acceleration; and

at least one object detection sensor for detecting an object in a vehicle path of the vehicle during the turn, said object detection sensor in electrical communication with said controller, wherein said controller includes control logic operative to determine whether the object is in the vehicle path during the turn and ignoring the object for braking purposes when the object is not determined to be in the vehicle path.

11. The system of claim **10** wherein said object detection sensor includes means for generating

an object range signal corresponding to a distance between the vehicle and the object; and

an object angle signal corresponding to the object's angle in relation to the vehicle.

12. The system of claim **11** wherein said controller includes both means for measuring an object range rate corresponding to the rate in which the distance between the vehicle and the object is changing, and means for determining a curvature corresponding to a radius of curvature of the vehicle path.

13. The system of claim **12** further comprising means for measuring the vehicle speed;

measuring a vehicle yaw rate; and

measuring a rate of change in the vehicle yaw rate.

14. The system of claim **13** wherein, upon said determaation whether the object is in the vehicle path during the turn, said controller uses yaw rate data corresponding to the vehicle yaw rate, yaw rate of change data corresponding to the change in the vehicle yaw rate, speed data corresponding to the vehicle speed, range data corresponding to the object range signal, range rate data corresponding to the object range rate, angle data corresponding to the object angle signal, and road curvature data corresponding to road curvature data, to verify that the object is in the vehicle path.

* * * * *

EXHIBIT 3

AO 88B (Rev. 12/13) Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in a Civil Action

UNITED STATES DISTRICT COURT

for the

District of Delaware

CARRUM TECHNOLOGIES, LLC
Plaintiff
v.
FCA US LLC
Defendant

Civil Action No. 18-cv-1646-RGA

SUBPOENA TO PRODUCE DOCUMENTS, INFORMATION, OR OBJECTS OR TO PERMIT INSPECTION OF PREMISES IN A CIVIL ACTION

To: Robert Bosch LLC ("Bosch"), 15000 Haggerty Road, Plymouth, MI 48170

(Name of person to whom this subpoena is directed)

☑ *Production:* **YOU ARE COMMANDED** to produce at the time, date, and place set forth below the following documents, electronically stored information, or objects, and to permit inspection, copying, testing, or sampling of the material: See attachment A

Place:	Date and Time:
Motor City Legal Process Servers LLC 607 Shelby Street, Suite 700 Detroit, Michigan 48226	07/21/2021 12:00 pm

☐ *Inspection of Premises:* **YOU ARE COMMANDED** to permit entry onto the designated premises, land, or other property possessed or controlled by you at the time, date, and location set forth below, so that the requesting party may inspect, measure, survey, photograph, test, or sample the property or any designated object or operation on it.

Place:	Date and Time:

The following provisions of Fed. R. Civ. P. 45 are attached – Rule 45(c), relating to the place of compliance; Rule 45(d), relating to your protection as a person subject to a subpoena; and Rule 45(e) and (g), relating to your duty to respond to this subpoena and the potential consequences of not doing so.

Date: 06/30/2021

CLERK OF COURT

OR

Signature of Clerk or Deputy Clerk

/s/ John Hughes
Attorney's signature

The name, address, e-mail address, and telephone number of the attorney representing *(name of party)* Plaintiff Carrum Technologies, LLC, who issues or requests this subpoena, are:

BARTLIT BECK LLP, 1801 Wewatta Street, Suite 1200, Denver, CO 80202

Notice to the person who issues or requests this subpoena

A notice and a copy of the subpoena must be served on each party in this case before it is served on the person to whom it is directed. Fed. R. Civ. P. 45(a)(4).

Civil Action No. 18-cv-1646-RGA

PROOF OF SERVICE

(This section should not be filed with the court unless required by Fed. R. Civ. P. 45.)

I received this subpoena for *(name of individual and title, if any)* _____

on *(date)* _____ .

❒ I served the subpoena by delivering a copy to the named person as follows: _____

_____

_____ on *(date)* _____ ; or

❒ I returned the subpoena unexecuted because: _____

_____ .

Unless the subpoena was issued on behalf of the United States, or one of its officers or agents, I have also tendered to the witness the fees for one day's attendance, and the mileage allowed by law, in the amount of $ _____ .

My fees are $ _____ for travel and $ _____ for services, for a total of $ 0.00 .

I declare under penalty of perjury that this information is true.

Date: _____

_____
Server's signature

_____
Printed name and title

_____
Server's address

Additional information regarding attempted service, etc.:

Federal Rule of Civil Procedure 45 (c), (d), (e), and (g) (Effective 12/1/13)

(c) Place of Compliance.

(1) ***For a Trial, Hearing, or Deposition.*** A subpoena may command a person to attend a trial, hearing, or deposition only as follows:
(A) within 100 miles of where the person resides, is employed, or regularly transacts business in person; or
(B) within the state where the person resides, is employed, or regularly transacts business in person, if the person
(i) is a party or a party's officer; or
(ii) is commanded to attend a trial and would not incur substantial expense.

(2) ***For Other Discovery.*** A subpoena may command:
(A) production of documents, electronically stored information, or tangible things at a place within 100 miles of where the person resides, is employed, or regularly transacts business in person; and
(B) inspection of premises at the premises to be inspected.

(d) Protecting a Person Subject to a Subpoena; Enforcement.

(1) ***Avoiding Undue Burden or Expense; Sanctions.*** A party or attorney responsible for issuing and serving a subpoena must take reasonable steps to avoid imposing undue burden or expense on a person subject to the subpoena. The court for the district where compliance is required must enforce this duty and impose an appropriate sanction—which may include lost earnings and reasonable attorney's fees—on a party or attorney who fails to comply.

(2) ***Command to Produce Materials or Permit Inspection.***
(A) *Appearance Not Required.* A person commanded to produce documents, electronically stored information, or tangible things, or to permit the inspection of premises, need not appear in person at the place of production or inspection unless also commanded to appear for a deposition, hearing, or trial.
(B) *Objections.* A person commanded to produce documents or tangible things or to permit inspection may serve on the party or attorney designated in the subpoena a written objection to inspecting, copying, testing, or sampling any or all of the materials or to inspecting the premises—or to producing electronically stored information in the form or forms requested. The objection must be served before the earlier of the time specified for compliance or 14 days after the subpoena is served. If an objection is made, the following rules apply:
(i) At any time, on notice to the commanded person, the serving party may move the court for the district where compliance is required for an order compelling production or inspection.
(ii) These acts may be required only as directed in the order, and the order must protect a person who is neither a party nor a party's officer from significant expense resulting from compliance.

(3) ***Quashing or Modifying a Subpoena.***
(A) *When Required.* On timely motion, the court for the district where compliance is required must quash or modify a subpoena that:
(i) fails to allow a reasonable time to comply;
(ii) requires a person to comply beyond the geographical limits specified in Rule 45(c);
(iii) requires disclosure of privileged or other protected matter, if no exception or waiver applies; or
(iv) subjects a person to undue burden.
(B) *When Permitted.* To protect a person subject to or affected by a subpoena, the court for the district where compliance is required may, on motion, quash or modify the subpoena if it requires:
(i) disclosing a trade secret or other confidential research, development, or commercial information; or
(ii) disclosing an unretained expert's opinion or information that does not describe specific occurrences in dispute and results from the expert's study that was not requested by a party.
(C) *Specifying Conditions as an Alternative.* In the circumstances described in Rule 45(d)(3)(B), the court may, instead of quashing or modifying a subpoena, order appearance or production under specified conditions if the serving party:
(i) shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship; and
(ii) ensures that the subpoenaed person will be reasonably compensated.

(e) Duties in Responding to a Subpoena.

(1) ***Producing Documents or Electronically Stored Information.*** These procedures apply to producing documents or electronically stored information:
(A) *Documents.* A person responding to a subpoena to produce documents must produce them as they are kept in the ordinary course of business or must organize and label them to correspond to the categories in the demand.
(B) *Form for Producing Electronically Stored Information Not Specified.* If a subpoena does not specify a form for producing electronically stored information, the person responding must produce it in a form or forms in which it is ordinarily maintained or in a reasonably usable form or forms.
(C) *Electronically Stored Information Produced in Only One Form.* The person responding need not produce the same electronically stored information in more than one form.
(D) *Inaccessible Electronically Stored Information.* The person responding need not provide discovery of electronically stored information from sources that the person identifies as not reasonably accessible because of undue burden or cost. On motion to compel discovery or for a protective order, the person responding must show that the information is not reasonably accessible because of undue burden or cost. If that showing is made, the court may nonetheless order discovery from such sources if the requesting party shows good cause, considering the limitations of Rule 26(b)(2)(C). The court may specify conditions for the discovery.

(2) ***Claiming Privilege or Protection.***
(A) *Information Withheld.* A person withholding subpoenaed information under a claim that it is privileged or subject to protection as trial-preparation material must:
(i) expressly make the claim; and
(ii) describe the nature of the withheld documents, communications, or tangible things in a manner that, without revealing information itself privileged or protected, will enable the parties to assess the claim.
(B) *Information Produced.* If information produced in response to a subpoena is subject to a claim of privilege or of protection as trial-preparation material, the person making the claim may notify any party that received the information of the claim and the basis for it. After being notified, a party must promptly return, sequester, or destroy the specified information and any copies it has; must not use or disclose the information until the claim is resolved; must take reasonable steps to retrieve the information if the party disclosed it before being notified; and may promptly present the information under seal to the court for the district where compliance is required for a determination of the claim. The person who produced the information must preserve the information until the claim is resolved.

(g) Contempt.
The court for the district where compliance is required—and also, after a motion is transferred, the issuing court—may hold in contempt a person who, having been served, fails without adequate excuse to obey the subpoena or an order related to it.

For access to subpoena materials, see Fed. R. Civ. P. 45(a) Committee Note (2013).

ATTACHMENT A

DEFINITIONS

1. "You" and "Your" means Robert Bosch LLC, and its parents, subsidiaries, divisions, affiliates, predecessors, assigns, successors, and acquired assets of business units, and any of its present or former officers, directors, trustees, employees, agents, representatives, attorneys, patent agents, and all other persons acting on its behalf.

2. "Defendants" means any or all of FCA US LLC; Ford Motor Company; BMW of North America, LLC; BMW Manufacturing Co., LLC; and Bayerische Motoren Werke AG; including their parents, subsidiaries, divisions, affiliates, predecessors, assigns, successors, and acquired assets of business units, and any of its present or former officers, directors, trustees, employees, agents, representatives, attorneys, patent agents, and all other persons acting on their behalf.

3. "Designated Component" means [redacted]

4. The term "Carrum" refers to Carrum Technologies, LLC and all of its predecessors, successors, officers, directors, principals, agents, employees,

independent contractors working under their control, and other persons acting on their behalf.

5. "Carrum Patents" means U.S. Patent Nos. 7,512,475 and 7,925,416, U.S. Patent Pub. 2005/0209766, U.S. Patent App. 10/804,745, U.S. Patent Pub. 2009/0150039, and U.S. Patent App. 12/371,792.

6. [redacted]

7. "Action" or "lawsuit" refers to any or all of *Carrum Technologies, LLC v. FCA*, C.A. No. 18-1646-RGA in the U.S. District Court for the District of Delaware; *Carrum Technologies, LLC v. Ford Motor Company*, C.A. No. 18-1647-RGA in the U.S. District Court for the District of Delaware; and *Carrum Technologies, LLC v. BMW of North America, LLC and BMW Manufacturing Co., LLC*, C.A. No. 18-1645-RGA in the U.S. District Court for the District of Delaware.

8. "Communication" means any transmission of information by one or more persons, received by one or more persons, and/or between two or more persons by any means.

9. "Source Code" means computer code (including, without limitation, source code (including human-readable programming language text that defines software), MATLAB or Simulink algorithms, computer-generated simulation models, Hardware Description Language (HDL), Register Transfer Level Code (RTL), microcode, or other similarly sensitive non-text computer generated material) that defines or otherwise describes in detail the algorithms or structure of computer software, firmware or hardware designs. Source Code also means and refers to all

".include files," "make" files, "link" files, and other human-readable text files used in the generation and/or building of software directly executed on a microprocessor, micro-controller, or other processor.

10. The term "document" is defined to be synonymous in meaning and equal in scope to the usage of the term "documents or electronically stored information" in Rule 34(a) of the Federal Rules of Civil Procedure. A draft or non-identical copy is a separate document within the meaning of this term.

11. "All documents" means any and all documents that might reasonably be located through a search of all locations reasonably likely to contain documents.

12. The terms "and" and "or" are to be construed conjunctively and disjunctively so as to achieve the broadest possible meaning.

13. The terms "all," "any," and "each" encompass "any and all."

14. "Including" means "including, but not limited to," or "including, without limitation," so that the Request shall acquire the broadest possible meaning. Likewise, "includes" means "includes, but is not limited to," or "includes, without limitation."

15. "Concerning," "referred to," "referring to," "refer to," "related to," "relating to," or "relate to," means, without limitation, assessing, comprising, constituting, containing, describing, discussing, embodying, evidencing, identifying, pertaining to, reflecting, stating, supporting, or tending to support or refute, or referring in any other way, directly or indirectly, in whole or in part, to the subject matter specified.

16. Where used in these Requests, the words "and" and "or" shall be conjunctive and disjunctive, the words "all" or "any" shall mean "all and any," and the word "including" means "including without limitation."

17. The use of a verb tense encompasses the use of that verb in all other tenses.

18. All references to the singular encompass the plural, and all references to the plural encompass the singular.

19. The use and definition of any of these words or terms is not contingent on the capitalization or lack of capitalization of those terms as used below. Some terms may be capitalized, including without limitation at the beginning of a sentence, or not capitalized—regardless, the above definitions should be considered to apply.

INSTRUCTIONS

1. If you require clarification of a definition of any term to comply with any Request, please contact an attorney for Carrum and request such clarification or definition.

2. In responding to these Requests, you shall produce all responsive documents in your possession, custody, or control or in the possession, custody, or control of any of your respective predecessors, successors, managing agents, agents, attorneys, accountants, or other representatives.

3. You shall deem a document to be in your control if you have the right to secure the document or a copy of the document from another person having possession or custody of the document.

4. You shall produce such documents as soon as is reasonably possible after they are located or obtained.

5. You shall answer each Request on the basis of your entire knowledge from all sources after conducting an appropriate good-faith inquiry and search.

6. If any responsive document was, but is no longer, in your possession or subject to your control, state whether it is (a) missing or lost; (b) destroyed; (c) transferred voluntarily or involuntarily to others; or (d) otherwise disposed of, and in each instance identify the name and address of its current or last known custodian, the circumstances surrounding such disposition, and any and all records pertaining to its loss, transfer, or destruction.

7. If you or your attorneys know of the existence of any document called for in a Request but such document or thing is not presently in your possession, custody, or control or in the possession, custody, or control of your agents, representatives, or attorneys, you shall so state in response to the Request, identify such document or thing in response to the Request, and identify the individual in whose possession, custody, or control the document or thing was last known to reside.

8. In the event you withhold any document on a claim of attorney/client privilege or work product immunity, provide a detailed privilege log that describes the nature and basis for your claim and the subject matter, date, recipients, and author of the document withheld in a manner sufficient to disclose facts upon which you rely in asserting your claim and to permit identification of the grounds and reasons for the document's withholding.

9. If you withhold a portion of any document responsive to these Requests under a claim of privilege pursuant to Instruction 8, produce any non-privileged portion of such document with the portion claimed to be privileged redacted.

10. Produce documents as they are maintained in the normal course of business and:

a. all associated file labels, file headings thereon, and file folders shall be produced together with the responsive documents from each file;

b. all documents that cannot be legibly copied shall be produced in their original form; otherwise you may produce photocopies; and

c. each page shall be given a discrete production number.

11. Except as qualified in Instructions 8 and 9, produce each document requested herein in its entirety, without deletion or excision regardless of whether you consider the entire document to be relevant or responsive to the Requests.

12. If you contend that it would be unreasonably burdensome to obtain and provide all the documents or information called for in response to any of these Requests, then for each such Request:

a. produce all documents and information that are available to Robert Bosch LLC without undertaking what is contended to be an unreasonable burden;

b. describe with particularity the efforts made by Robert Bosch LLC or on Robert Bosch LLC's behalf to secure such documents and information; and

c. state with particularity the grounds on which Robert Bosch LLC contends that additional efforts to obtain such documents or information would be unreasonably burdensome.

13. To the extent you object to any of the Requests, you must state whether any responsive materials are being withheld on the basis of that objection, produce all documents responsive to the Requests to which you object to the extent such partial production is not objectionable, and explain in detail the basis on which such partial production was made for any such Request.

14. Electronic records or computerized information shall be produced in an intelligible format, together with a description of the system from which the information was obtained and the name of the program that may be used to access or read the records or information sufficient to permit rendering the materials intelligible.

DOCUMENTS AND THINGS TO BE PRODUCED

REQUEST FOR PRODUCTION NO. 1:

All user manuals and instructional documents regarding [redacted], in effect on or after October 23, 2012, [redacted].

REQUEST FOR PRODUCTION NO. 2:

Documents sufficient to show the programming, testing, installation, maintenance, and/or repair of [redacted]

REQUEST FOR PRODUCTION NO. 3:

Documents sufficient to show the design, specifications, operation, and/or function of [redacted], including but not limited to schematics, engineering guides, and system manuals.

REQUEST FOR PRODUCTION NO. 4:

All Source Code related to [redacted], which includes the algorithms or formulas employed by, or integrated into, [redacted]

For purposes of this request, all software should be provided in the form it is created and reviewed by a human. Wherever applicable, provide native documents (e.g., PDFs, PowerPoints, Word documents)—not scans—that: specify the functional requirements of the code, controls, and calibrations (e.g., a written description of the code and block/flow diagrams) that describe how the code/controls/calibrations will be programmed; and explain how the code, controls, and calibrations are implemented (e.g., documents that include Simulink diagrams, in native searchable form).

REQUEST FOR PRODUCTION NO. 5:

Documents and materials created by you (or by any third party on your behalf) promoting and/or marketing [redacted]

REQUEST FOR PRODUCTION NO. 6:

All manufacturing, supply, and development agreements with the Defendants relating to [redacted].

REQUEST FOR PRODUCTION NO. 7:

All documents concerning any non-privileged communications between You and anyone that discuss or refer to the lawsuit.

REQUEST FOR PRODUCTION NO. 8:

All documents, including any non-privileged communications between You and anyone, referring or relating to Carrum and/or the Carrum Patents.

REQUEST FOR PRODUCTION NO. 9:

All documents relating to the infringement of the Carrum Patents by any [redacted], including but not limited to a comparison between the Carrum Patents and [redacted].

EXHIBIT 4

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

CARRUM TECHNOLOGIES, LLC Plaintiff, v. FCA US LLC, Defendant.	C.A. No. 18-1646-RGA **FILED UNDER SEAL**

NOTICE OF SUBPOENA

PLEASE TAKE NOTICE that, pursuant to Rule 45 of the Federal Rules of Civil Procedure, Plaintiff Carrum Technologies, LLC will serve a subpoena on Robert Bosch LLC, attached as Exhibit 1.

Dated: October 4, 2021

Respectfully submitted,

FARNAN LLP

/s/ Brian E. Farnan
Brian E. Farnan (Bar No. 4089)
Michael J. Farnan (Bar No. 5165)
919 N. Market Street, 12th Floor
Wilmington, DE 19801
Telephone: (302) 777-0300
Fax: (302) 777-0301
bfarnan@farnanlaw.com
mfarnan@farnanlaw.com

John Hughes (admitted *pro hac vice*)
Andrew Baak (admitted *pro hac vice*)
Dan Brody (admitted *pro hac vice*)
Jason Murray (admitted *pro hac vice*)
Meg Fasulo (admitted *pro hac vice*)
Bartlit Beck LLP
1801 Wewatta Street, Ste. 1200
Denver, CO 80202
Telephone: (303) 592-3100
john.hughes@bartlitbeck.com
andrew.baak@bartlitbeck.com

dan.brody@bartlitbeck.com
jason.murray@bartlitbeck.com
meg.fasulo@bartlitbeck.com

Rebecca T. Horwitz (admitted *pro hac vice*)
BARTLIT BECK LLP
54 W. Hubbard Street, Suite 300
Chicago, IL 60654
Tel: (312) 494-4400
rebecca.horwitz@bartlitbeck.com

John Vivian (admitted *pro hac vice*)
Hilgers Graben PLLC
601 Pennsylvania Ave. NW
South Building, Suite 900
Washington, D.C. 20004
Tel. (240) 332-8749
jvivian@hilgersgraben.com

Andrew R. Graben (admitted *pro hac vice*)
Hilgers Graben PLLC
10000 N. Central Expressway, Suite 400
Dallas, TX 75321
Tel. (214) 842-6828
agraben@hilgersgraben.com

Trenton D. Tanner (admitted *pro hac vice*)
Hilgers Graben PLLC
575 Fallbrook Blvd., Suite 202
Lincoln, NE 68521
Tel. (402) 218-2106
ttanner@hilgersgraben.com

Counsel for Plaintiff Carrum Technologies, LLC

EXHIBIT 1

AO 88B (Rev. 12/13) Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in a Civil Action

UNITED STATES DISTRICT COURT

for the

District of Delaware

CARRUM TECHNOLOGIES, LLC
Plaintiff
v.
FCA US LLC
Defendant

Civil Action No. 18-cv-1646-RGA

SUBPOENA TO PRODUCE DOCUMENTS, INFORMATION, OR OBJECTS OR TO PERMIT INSPECTION OF PREMISES IN A CIVIL ACTION

To: Robert Bosch LLC ("Bosch"), 15000 Haggerty Road, Plymouth, MI 48170

(Name of person to whom this subpoena is directed)

☑ *Production:* **YOU ARE COMMANDED** to produce at the time, date, and place set forth below the following documents, electronically stored information, or objects, and to permit inspection, copying, testing, or sampling of the material: See attachment A

Place:	Date and Time:
Motor City Legal Process Servers LLC 607 Shelby Street, Suite 700 Detroit, Michigan 48226	10/20/2021 12:00 pm

☐ *Inspection of Premises:* **YOU ARE COMMANDED** to permit entry onto the designated premises, land, or other property possessed or controlled by you at the time, date, and location set forth below, so that the requesting party may inspect, measure, survey, photograph, test, or sample the property or any designated object or operation on it.

Place:	Date and Time:

The following provisions of Fed. R. Civ. P. 45 are attached – Rule 45(c), relating to the place of compliance; Rule 45(d), relating to your protection as a person subject to a subpoena; and Rule 45(e) and (g), relating to your duty to respond to this subpoena and the potential consequences of not doing so.

Date: 10/04/2021

CLERK OF COURT

OR

Signature of Clerk or Deputy Clerk

/s/ Trent Tanner
Attorney's signature

The name, address, e-mail address, and telephone number of the attorney representing *(name of party)* Plaintiff Carrum Technologies, LLC, who issues or requests this subpoena, are:

Trent Tanner, HILGERS GRABEN PLLC, 575 Fallbrook Blvd., Suite 202, Lincoln, NE 68521, ttanner@hilgersgraben.com (402)260-1391

Notice to the person who issues or requests this subpoena

A notice and a copy of the subpoena must be served on each party in this case before it is served on the person to whom it is directed. Fed. R. Civ. P. 45(a)(4).

Civil Action No. 18-cv-1646-RGA

PROOF OF SERVICE

(This section should not be filed with the court unless required by Fed. R. Civ. P. 45.)

I received this subpoena for *(name of individual and title, if any)* _____

on *(date)* _____ .

❒ I served the subpoena by delivering a copy to the named person as follows: _____

_____

_____ on *(date)* _____ ; or

❒ I returned the subpoena unexecuted because: _____

_____ .

Unless the subpoena was issued on behalf of the United States, or one of its officers or agents, I have also tendered to the witness the fees for one day's attendance, and the mileage allowed by law, in the amount of $ _____ .

My fees are $ _____ for travel and $ _____ for services, for a total of $ 0.00 .

I declare under penalty of perjury that this information is true.

Date: _____

_____
Server's signature

_____
Printed name and title

_____
Server's address

Additional information regarding attempted service, etc.:

Federal Rule of Civil Procedure 45 (c), (d), (e), and (g) (Effective 12/1/13)

(c) Place of Compliance.

(1) ***For a Trial, Hearing, or Deposition.*** A subpoena may command a person to attend a trial, hearing, or deposition only as follows:

(A) within 100 miles of where the person resides, is employed, or regularly transacts business in person; or

(B) within the state where the person resides, is employed, or regularly transacts business in person, if the person

(i) is a party or a party's officer; or

(ii) is commanded to attend a trial and would not incur substantial expense.

(2) ***For Other Discovery.*** A subpoena may command:

(A) production of documents, electronically stored information, or tangible things at a place within 100 miles of where the person resides, is employed, or regularly transacts business in person; and

(B) inspection of premises at the premises to be inspected.

(d) Protecting a Person Subject to a Subpoena; Enforcement.

(1) ***Avoiding Undue Burden or Expense; Sanctions.*** A party or attorney responsible for issuing and serving a subpoena must take reasonable steps to avoid imposing undue burden or expense on a person subject to the subpoena. The court for the district where compliance is required must enforce this duty and impose an appropriate sanction—which may include lost earnings and reasonable attorney's fees—on a party or attorney who fails to comply.

(2) ***Command to Produce Materials or Permit Inspection.***

(A) *Appearance Not Required.* A person commanded to produce documents, electronically stored information, or tangible things, or to permit the inspection of premises, need not appear in person at the place of production or inspection unless also commanded to appear for a deposition, hearing, or trial.

(B) *Objections.* A person commanded to produce documents or tangible things or to permit inspection may serve on the party or attorney designated in the subpoena a written objection to inspecting, copying, testing, or sampling any or all of the materials or to inspecting the premises—or to producing electronically stored information in the form or forms requested. The objection must be served before the earlier of the time specified for compliance or 14 days after the subpoena is served. If an objection is made, the following rules apply:

(i) At any time, on notice to the commanded person, the serving party may move the court for the district where compliance is required for an order compelling production or inspection.

(ii) These acts may be required only as directed in the order, and the order must protect a person who is neither a party nor a party's officer from significant expense resulting from compliance.

(3) ***Quashing or Modifying a Subpoena.***

(A) *When Required.* On timely motion, the court for the district where compliance is required must quash or modify a subpoena that:

(i) fails to allow a reasonable time to comply;

(ii) requires a person to comply beyond the geographical limits specified in Rule 45(c);

(iii) requires disclosure of privileged or other protected matter, if no exception or waiver applies; or

(iv) subjects a person to undue burden.

(B) *When Permitted.* To protect a person subject to or affected by a subpoena, the court for the district where compliance is required may, on motion, quash or modify the subpoena if it requires:

(i) disclosing a trade secret or other confidential research, development, or commercial information; or

(ii) disclosing an unretained expert's opinion or information that does not describe specific occurrences in dispute and results from the expert's study that was not requested by a party.

(C) *Specifying Conditions as an Alternative.* In the circumstances described in Rule 45(d)(3)(B), the court may, instead of quashing or modifying a subpoena, order appearance or production under specified conditions if the serving party:

(i) shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship; and

(ii) ensures that the subpoenaed person will be reasonably compensated.

(e) Duties in Responding to a Subpoena.

(1) ***Producing Documents or Electronically Stored Information.*** These procedures apply to producing documents or electronically stored information:

(A) *Documents.* A person responding to a subpoena to produce documents must produce them as they are kept in the ordinary course of business or must organize and label them to correspond to the categories in the demand.

(B) *Form for Producing Electronically Stored Information Not Specified.* If a subpoena does not specify a form for producing electronically stored information, the person responding must produce it in a form or forms in which it is ordinarily maintained or in a reasonably usable form or forms.

(C) *Electronically Stored Information Produced in Only One Form.* The person responding need not produce the same electronically stored information in more than one form.

(D) *Inaccessible Electronically Stored Information.* The person responding need not provide discovery of electronically stored information from sources that the person identifies as not reasonably accessible because of undue burden or cost. On motion to compel discovery or for a protective order, the person responding must show that the information is not reasonably accessible because of undue burden or cost. If that showing is made, the court may nonetheless order discovery from such sources if the requesting party shows good cause, considering the limitations of Rule 26(b)(2)(C). The court may specify conditions for the discovery.

(2) ***Claiming Privilege or Protection.***

(A) *Information Withheld.* A person withholding subpoenaed information under a claim that it is privileged or subject to protection as trial-preparation material must:

(i) expressly make the claim; and

(ii) describe the nature of the withheld documents, communications, or tangible things in a manner that, without revealing information itself privileged or protected, will enable the parties to assess the claim.

(B) *Information Produced.* If information produced in response to a subpoena is subject to a claim of privilege or of protection as trial-preparation material, the person making the claim may notify any party that received the information of the claim and the basis for it. After being notified, a party must promptly return, sequester, or destroy the specified information and any copies it has; must not use or disclose the information until the claim is resolved; must take reasonable steps to retrieve the information if the party disclosed it before being notified; and may promptly present the information under seal to the court for the district where compliance is required for a determination of the claim. The person who produced the information must preserve the information until the claim is resolved.

(g) Contempt.

The court for the district where compliance is required—and also, after a motion is transferred, the issuing court—may hold in contempt a person who, having been served, fails without adequate excuse to obey the subpoena or an order related to it.

For access to subpoena materials, see Fed. R. Civ. P. 45(a) Committee Note (2013).

ATTACHMENT A

DEFINITIONS

1. "You" and "Your" means Robert Bosch LLC, and its parents, subsidiaries, divisions, affiliates, predecessors, assigns, successors, and acquired assets of business units, and any of its present or former officers, directors, trustees, employees, agents, representatives, attorneys, patent agents, and all other persons acting on its behalf.

2. "Defendants" means any or all of FCA US LLC; Ford Motor Company; BMW of North America, LLC; BMW Manufacturing Co., LLC; and Bayerische Motoren Werke AG; including their parents, subsidiaries, divisions, affiliates, predecessors, assigns, successors, and acquired assets of business units.

3. "Designated Camera Components" means [redacted].[1]

[1] [redacted]

4. [redacted]

5. The term "Carrum" refers to Carrum Technologies, LLC and all of its predecessors, successors, officers, directors, principals, agents, employees, independent contractors working under their control, and other persons acting on their behalf.

6. "Carrum Patents" means U.S. Patent Nos. 7,512,475 and 7,925,416, U.S. Patent Pub. 2005/0209766, U.S. Patent App. 10/804,745, U.S. Patent Pub. 2009/0150039, and U.S. Patent App. 12/371,792.

7. [redacted]

8. "Action" or "lawsuit" refers to any or all of *Carrum Technologies, LLC v. FCA*, C.A. No. 18-1646-RGA in the U.S. District Court for the District of Delaware; *Carrum Technologies, LLC v. Ford Motor Company*, C.A. No. 18-1647-RGA in the

[redacted]

U.S. District Court for the District of Delaware; and *Carrum Technologies, LLC v. BMW of North America, LLC and BMW Manufacturing Co., LLC*, C.A. No. 18-1645-RGA in the U.S. District Court for the District of Delaware.

9. "Communication" means any transmission of information by one or more persons, received by one or more persons, and/or between two or more persons by any means.

10. "Source Code" means computer code (including, without limitation, source code (including human-readable programming language text that defines software), MATLAB or Simulink algorithms, computer-generated simulation models, Hardware Description Language (HDL), Register Transfer Level Code (RTL), microcode, or other similarly sensitive non-text computer generated material) that defines or otherwise describes in detail the algorithms or structure of computer software, firmware or hardware designs. Source Code also means and refers to all ".include files," "make" files, "link" files, and other human-readable text files used in the generation and/or building of software directly executed on a microprocessor, micro-controller, or other processor.

11. The term "document" is defined to be synonymous in meaning and equal in scope to the usage of the term "documents or electronically stored information" in Rule 34(a) of the Federal Rules of Civil Procedure. A draft or non-identical copy is a separate document within the meaning of this term.

12. "All documents" means any and all documents that might reasonably be located through a search of all locations reasonably likely to contain documents.

13. The terms "and" and "or" are to be construed conjunctively and disjunctively so as to achieve the broadest possible meaning.

14. The terms "all," "any," and "each" encompass "any and all."

15. "Including" means "including, but not limited to," or "including, without limitation," so that the Request shall acquire the broadest possible meaning. Likewise, "includes" means "includes, but is not limited to," or "includes, without limitation."

16. "Concerning," "referred to," "referring to," "refer to," "related to," "relating to," or "relate to," means, without limitation, assessing, comprising, constituting, containing, describing, discussing, embodying, evidencing, identifying, pertaining to, reflecting, stating, supporting, or tending to support or refute, or referring in any other way, directly or indirectly, in whole or in part, to the subject matter specified.

17. Where used in these Requests, the words "and" and "or" shall be conjunctive and disjunctive, the words "all" or "any" shall mean "all and any," and the word "including" means "including without limitation."

18. The use of a verb tense encompasses the use of that verb in all other tenses.

19. All references to the singular encompass the plural, and all references to the plural encompass the singular.

20. The use and definition of any of these words or terms is not contingent on the capitalization or lack of capitalization of those terms as used below. Some

terms may be capitalized, including without limitation at the beginning of a sentence, or not capitalized—regardless, the above definitions should be considered to apply.

INSTRUCTIONS

1. If you require clarification of a definition of any term to comply with any Request, please contact an attorney for Carrum and request such clarification or definition.

2. In responding to these Requests, you shall produce all responsive documents in your possession, custody, or control or in the possession, custody, or control of any of your respective predecessors, successors, managing agents, agents, attorneys, accountants, or other representatives.

3. You shall deem a document to be in your control if you have the right to secure the document or a copy of the document from another person having possession or custody of the document.

4. You shall produce such documents as soon as is reasonably possible after they are located or obtained.

5. You shall answer each Request on the basis of your entire knowledge from all sources after conducting an appropriate good-faith inquiry and search.

6. If any responsive document was, but is no longer, in your possession or subject to your control, state whether it is (a) missing or lost; (b) destroyed; (c) transferred voluntarily or involuntarily to others; or (d) otherwise disposed of, and in each instance identify the name and address of its current or last known custodian,

the circumstances surrounding such disposition, and any and all records pertaining to its loss, transfer, or destruction.

7. If you or your attorneys know of the existence of any document called for in a Request but such document or thing is not presently in your possession, custody, or control or in the possession, custody, or control of your agents, representatives, or attorneys, you shall so state in response to the Request, identify such document or thing in response to the Request, and identify the individual in whose possession, custody, or control the document or thing was last known to reside.

8. In the event you withhold any document on a claim of attorney/client privilege or work product immunity, provide a detailed privilege log that describes the nature and basis for your claim and the subject matter, date, recipients, and author of the document withheld in a manner sufficient to disclose facts upon which you rely in asserting your claim and to permit identification of the grounds and reasons for the document's withholding.

9. If you withhold a portion of any document responsive to these Requests under a claim of privilege pursuant to Instruction 8, produce any non-privileged portion of such document with the portion claimed to be privileged redacted.

10. Produce documents as they are maintained in the normal course of business and:

a. all associated metadata fields (including custodian, File Path, Email Subject, Conversation Index, From, To, CC, BCC, Date Sent, Time Sent, Date Received, Time Received, Filename,

Author, Date Created, Date Modified, MD5 Hash, File Size, and File Extension), file labels, file headings thereon, and file folders shall be produced together with the responsive documents from each file;

b. all documents that cannot be legibly copied shall be produced in their original form; otherwise you may produce photocopies; and

c. each page shall be given a discrete production number.

11. Except as qualified in Instructions 8 and 9, produce each document requested herein in its entirety, without deletion or excision regardless of whether you consider the entire document to be relevant or responsive to the Requests.

12. If you contend that it would be unreasonably burdensome to obtain and provide all the documents or information called for in response to any of these Requests, then for each such Request:

a. produce all documents and information that are available to Robert Bosch LLC without undertaking what is contended to be an unreasonable burden;

b. describe with particularity the efforts made by Robert Bosch LLC or on Robert Bosch LLC's behalf to secure such documents and information; and

c. state with particularity the grounds on which Robert Bosch LLC contends that additional efforts to obtain such documents or information would be unreasonably burdensome.

13. To the extent you object to any of the Requests, you must state whether any responsive materials are being withheld on the basis of that objection, produce all documents responsive to the Requests to which you object to the extent such partial production is not objectionable, and explain in detail the basis on which such partial production was made for any such Request.

14. Electronic records or computerized information shall be produced in an intelligible format, together with a description of the system from which the information was obtained and the name of the program that may be used to access or read the records or information sufficient to permit rendering the materials intelligible.

DOCUMENTS AND THINGS TO BE PRODUCED

REQUEST FOR PRODUCTION NO. 10[2]:

Documents sufficient to show the design, specifications, operation, and/or function of [redacted], including but not limited to schematics, engineering guides, and system manuals.

REQUEST FOR PRODUCTION NO. 11:

All Source Code [redacted], which includes the algorithms or formulas employed by, or integrated into, [redacted]

For purposes of this request, all software should be provided in the form it is created and reviewed by a human. Wherever applicable, provide native documents (e.g., PDFs, PowerPoints, Word documents)—not scans—that: specify the functional requirements of the code, controls, and calibrations (e.g., a written description of the code and block/flow diagrams) that describe how the code/controls/calibrations will be programmed; and explain how the code, controls, and calibrations are implemented (e.g., documents that include Simulink diagrams, in native searchable form).

[2] These RFPs are numbered sequentially from the RFP numbers in the original Subpoena to Bosch, dated June 30, 2021, that Carrum served in these actions.

REQUEST FOR PRODUCTION NO. 12:

Documents sufficient to show the design, specifications, operation, and/or function of the [redacted], including but not limited to schematics, engineering guides, and system manuals.

REQUEST FOR PRODUCTION NO. 13:

All Source Code related to [redacted], which includes the algorithms or formulas employed by, or integrated into, [redacted]

For purposes of this request, all software should be provided in the form it is created and reviewed by a human. Wherever applicable, provide native documents (e.g., PDFs, PowerPoints, Word documents)—not scans—that: specify the functional requirements of the code, controls, and calibrations (e.g., a written description of the code and block/flow diagrams) that describe how the code/controls/calibrations will be programmed; and explain how the code, controls, and calibrations are implemented (e.g., documents that include Simulink diagrams, in native searchable form).

EXHIBIT 5

[REDACTED IN ITS ENTIRETY]

EXHIBIT 6

[REDACTED IN ITS ENTIRETY]

EXHIBIT 7

[REDACTED IN ITS ENTIRETY]

EXHIBIT 8

[REDACTED IN ITS ENTIRETY]

EXHIBIT 9

[REDACTED IN ITS ENTIRETY]

EXHIBIT 10

[REDACTED IN ITS ENTIRETY]

EXHIBIT 11

[REDACTED IN ITS ENTIRETY]

EXHIBIT 12

[REDACTED IN ITS ENTIRETY]

EXHIBIT 13

[REDACTED IN ITS ENTIRETY]

EXHIBIT 14

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexamination of:	)	
	)	
U.S. Patent No. 7,512,475	)	
	)	
Issued: March 31, 2009	)	Group Art Unit: To Be Assigned
	)	
Named Inventors: Robert A. Perisho, Jr. and Jeremy S. Greene	)	Examiner: To Be Assigned
	)	
Control Number: To Be Assigned	)	
	)	
Filed: March 19, 2004	)	
	)	
Title: AUTOMATIC LATERAL ACCELERATION LIMITING AND NON THREAT TARGET REJECTION	)	

Mail Stop *Ex Parte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

REQUEST FOR *EX PARTE* REEXAMINATION

Robert Bosch, LLC ("Requestor") respectfully requests *ex parte* reexamination of claims 2, 3, 5, 7, and 9-12 of U.S. Patent No. 7,512,475 ("the '475 patent," EX. 1001), assigned to Carrum Technologies, LLC ("Patent Owner"). Claims 1, 4, 6, and 8 have already been found invalid by the Patent Trial and Appeal Board. The prior art cited herein renders the remaining claims unpatentable under 35 U.S.C. § 103.

On October 23, 2018, Patent Owner filed complaints in the United States District Court for the District of Delaware asserting the '475 patent against BMW of North America, LLC, BMW Manufacturing Co., LLC, Ford Motor Company, and FCA US LLC. EX. 1004. On April 20, 2019, BMW of North America, LLC and Ford Motor Company filed a petition for *inter*

EXHIBIT 15

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN

Carrum Technologies, LLC, Plaintiff, v. FCA US LLC, Defendant. C.A. No. 18-cv-1646-RGA United States District Court for the District of Delaware	Misc. Case No.

DECLARATION OF JASON MURRAY IN SUPPORT OF PLAINTIFF'S MOTION TO COMPEL COMPLIANCE WITH RULE 45 SUBPOENA ISSUED FROM THE DISTRICT OF DELAWARE TO NON-PARTY BOSCH

I, Jason Murray, swear under penalty of perjury under the laws of the United States to the following:

1. I am over the age of 18 and competent to be a witness. I am making this Declaration based on facts within my own personal knowledge. I provide this Declaration in support of Plaintiff's Motion to Compel Compliance with Rule 45 Subpoena Issued from the District of Delaware to Non-Party Bosch ("Motion to Compel").

2. I am counsel of record for Plaintiff Carrum Technologies, LLC ("Carrum" or "Plaintiff") in the patent infringement action *Carrum Technologies, LLC v. FCA*, C.A. No. 18-1646-RGA (D. Del.) ("*Carrum v. FCA*"), which is currently pending before the Honorable Judge Richard G. Andrews in the U.S. District Court for the District of Delaware.

3. In *Carrum v. FCA*, Plaintiff has accused the defendant automobile manufacturer of infringing Plaintiff's United States Patent Nos. 7,512,475 ("the '475 patent") and 7,925,416 ("the '416 patent") (collectively, the "Asserted Patents"). True and correct copies of the Asserted Patents are attached as Exhibits 1 ('475 patent) and 2 ('416 patent).

4. On June 30, 2021, Carrum served Robert Bosch LLC ("Bosch") with a subpoena in connection with *Carrum v. FCA*. A true and correct copy of this subpoena is attached as Exhibit 3.

5. On October 4, 2021, Carrum served Bosch with a second subpoena in connection with *Carrum v. FCA*. A true and correct copy of this subpoena is attached as Exhibit 4.

6. I refer to the June 30 and October 4 subpoenas collectively as "the Subpoenas."

7. On July 30, 2021, Bosch sent a letter to Carrum stating Bosch's objections and responses to the June 30 subpoena. A true and correct copy of this letter is attached as Exhibit 5.

8. On October 20, 2021, Bosch sent a letter to Carrum stating Aptiv's objections and responses to the October 4 subpoena. A true and correct copy of this letter is attached as Exhibit 6.

9. Counsel for Carrum and counsel for Bosch have also exchanged email correspondence regarding the Subpoenas. A true and correct copy of email correspondence, spanning the dates August 30, 2021, through September 15, 2021, is attached as Exhibit 7. A true and correct copy of email correspondence, spanning the dates September 3, 2021, through November 5, 2021, is attached as Exhibit 8. A true and correct copy of email correspondence, spanning the dates November 3, 2021, through December 17, 2021, is attached as Exhibit 9.

10. On November 16, 2021, counsel for FCA sent an email to counsel for Carrum regarding discovery that Carrum seeks from FCA in *Carrum v. FCA*. A true and correct copy of this email is attached as Exhibit 10.

11. Bosch has produced various documents to Carrum in response to Carrum's Subpoenas. I am generally familiar with the contents of those productions. Several documents produced by Bosch are cited in Plaintiff's Brief in Support of the instant Motion: BOSCH099448, BOSCH006330 (cited pages), and BOSCH112936. True and correct copies of these documents are attached as Exhibits 11, 12, and 13, respectively.

12. Fact discovery in the Delaware litigation is ongoing. Throughout fact discovery, I have been a party to various email correspondence and telephonic meet

and confers with counsel for Defendant FCA. [redacted]

13. On August 27, 2021, Robert Bosch, LLC filed a Request for *Ex Parte* Reexamination of U.S. Patent No. 7,512,475 with the U.S. Patent and Trademark Office. A true and correct copy of the cover page of this request is attached as Exhibit 14.

I declare under penalty of perjury that the foregoing is true and correct.

DATED: December 22, 2021

Jason Murray

EXHIBIT 16

[REDACTED IN ITS ENTIRETY]